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PREFACE

January 22, 1989 marks two occasions in the life of Harry D. Thiers, his 70th birthday, and more importantly, his retirement from 30 years of teaching at San Francisco State University. A teacher often measures his success by that of his students, therefore we hope that this volume of 20 research papers on mycology and lichenology by his students will bring Harry pleasure and a sense of accomplishment.

Festschrift projects often have the reputation of being far more time-consuming and difficult than the organizers envision at the outset. We admit to spending more time on this one than we thought we would, even with the help of *XyWrite III+* and a laser printer. However, we have found the rewards of the project to be far greater than the time invested; we have renewed contact with many old friends, chuckled over forgotten anecdotes, and expanded our mycological and editorial horizons.

In the process, we learned something about Harry Thiers as well. . .he must be one of the world's most inquisitive people. We resolved to keep this Festschrift secret from him as long as possible. During our semi-annual visits to San Francisco over the last two and a half years we have tried many times to accomplish Festschrift-related business through a furtive poke in the herbarium or a hushed conference in the corner. More often than not, the Festschrift Honoree would catch us in the act, and some fancy footwork was needed to misrepresent our activities convincingly. Only Ellen Thiers proved to be cunning and cool-headed enough to succeed in ferreting crucial data from under Harry's nose.

In the introductory section to this volume, many fine and well-deserved tributes are paid to Harry. We know he would want us to reiterate here something he has said many times: he feels extraordinarily lucky to have had such a fine assortment of students. They are every bit as special to him as he is to them.

We wish to give our warmest thanks to all of the Festschrift participants. Special thanks are also due to Ernst Both, Director, Buffalo Museum of Science, for donating the cover artwork (*Leccinum manzanitae* Thiers) executed by Patricia Eckel, and to The New York Botanical Garden for helping to manage finances of the project. Generous financial contributions from W. P. Jordan, B. K. Tamm, and an anonymous donor are very much appreciated. Richard P. Korf, Managing Editor of MYCOTAXON was extremely helpful and accommodating at every step of the project, and we are very grateful to him for making this volume possible.

Roy E. Halling
Barbara M. Thiers
Guest Co-editors
Bronx, NY

HARRY D. THIERS - REMINISCENCES ABOUT A TEACHER AND FRIEND

I served as laboratory assistant for HDT beginning in my sophomore year at Texas A & M in College Station, Texas. Harry supervised two beginning botany labs simultaneously. During the laboratory on stems, I was charged with giving the introduction to the class in one of the labs. I confidently showed the class where the cambium was located in a corn stem. HDT came into the room and very courteously took over the class, and relectured monocot stems from the same chart. I was very embarrassed, but as usual, he was very patient, and on we went. My first mycology course was with Harry. He was an excellent instructor, and the laboratories were very well planned. The lab with the water molds was amply supplied with examples of discharging zoosporangia. This was the first time I had seen the discharge and the zoospores swimming about. I stayed a long time looking at this material, and got so excited that I had to go home to bed to recover. [Don Reynolds].

* * * * * *

As an undergraduate at San Francisco State, I was assigned an advisor in the Department of Biology, one Robert Sweeney. I was something of an annoyance to him because I continually brought mushrooms I'd collected in the environs of the campus to our scheduled meetings. Bob's response, invariably was, "I don't know anything about those damn things." One afternoon, Bob stopped me in the hall and informed me that the department had just hired a mycologist, and I should talk to him about those damnable mushrooms.

Bearing a freshly collected specimen, I promptly presented myself to Harry Thiers. Harry, looking a bit frazzled, was busy emptying many boxes of books. Nevertheless, he greeted me and my mushroom with great enthusiasm. As is so typical of him, rather than simply identifying the mushroom for me, Harry feigned ignorance, reached into his collection of books, and introduced me to the dichotomous key. We keyed out the mushroom together.

Harry's response to me and my interest was all the encouragement I needed. Almost daily I would bring in specimens to identify. Soon, we began to take short trips together looking for fungi. The very next semester, Harry set me up in the tiny back room to his office. I was provided with a microscope, a bottle of Melzer's, a straight razor, and a mimeographed copy of Alex Smith's "Preliminary key to the Fleshy Fungi." I remember Harry taking great delight watching me trying to section a minute *Mycena* without simultaneously removing the end of my finger.

We took many trips then. . . .Land's End, Crystal Springs reservoir, the Presidio, Skyline Drive. . . .anywhere a mushroom might grow. Each trip would end with a mini lecture on morphology or taxonomy, and, in a pattern that typifies Harry's lab even to this day, hours of keying out mushrooms. These were exciting times for me and irreversibly directed my path to a career in mycology. [Jerry Motta]

* * * * * *

In the later 1950's, the science faculty of San Francisco State required all Biological Science students--regardless of their major interest--to experience a few Botany classes. As a neophyte biological science major with a presumptive interest in zoology, Botany would not have been one of my elective choices. The required first semester course did little to change my mind and convinced me to complete my botany requirements as quickly as possible by taking the second semester of the introductory course rather than the alternative--an upper division Botany elective at a later date.

Walking into that second semester Botany class with only 14 other students in the room, when there had been nearly 50 in the first semester course, I quickly began to wonder what I had gotten myself into! The first day's lecture in the class consisted of an overview of what we were going to cover during the semester, with review, wherever it fit in, of terms and concepts we had "learned" in the previous course. Unusual? No. But, Dr. Thiers, the instructor, who had recently come to S. F. State from Texas, didn't just lecture. He started almost immediately to involve the class in the process by requesting definitions, asking questions, etc. And, much to my surprise, he was calling on people that first day in class by name--often without even turning around from the blackboard!! (I learned later that many of the others in class had been in Professor Thiers' laboratory section the semester before--I had not). Realizing that my learning of the first semester's material was less than adequate for this approach, I became quickly aware that if I was to survive this experience, something had to be done--and fast!! Extra Botany books were obtained from the library; notes were recopied, embellished for clarity, and repeatedly reviewed; vocabulary lists, constantly being upgraded, were always in hand. Botany between classes, Botany at meals, Botany on the bus commuting to and from work. Sometime early in the semester, the "chore" of studying became a joy. Through Dr. Thiers' enthusiasm and excitement, Botany came alive for me in that class and my life was forever changed.

In my graduate school days at San Francisco State in the mid-1960's, the herbarium was a home away from home. Converted from a small storeroom in the original square Science building, it served as the Botany graduate student office, work-study area, and general meeting place. The five to six graduate students had work spaces sandwiched between, around, and behind the seven or eight herbarium cases; one had a desk looking into the unused freight elevator door! Closeness created life-long friendships. Often arriving before others in the morning, HDT was always there to answer our questions, offer advice and support, and share in the excitement of our discoveries. Like the coffee always brewing, the love of Botany, of science, and of knowing, was rich there. [Walter J. Sundberg]

* * * * * *

I first met Dr. Harry Thiers in 1960 when I left a high school teaching job to further my education. It was a fortuitous meeting for me! During 1960-1961, he was the nucleus of my forming career, and ever since then, the impression of his wonderful enthusiasm for everything, especially fungi and students, has helped me shape my teaching and research career.

When I came to SFSU in 1960, I hoped that I could get a masters degree, possibly in marine algae under Dr. George Oberlander. My chagrin at learning that he was on sabbatical leave (in Australia) was quickly alleviated when I met Dr. Thiers. Although his primary interest was fungi, he was flexible and quite amenable when I came up with a plan on ferns. So that fall term, I began growing fern gametophytes on liquid media and testing their responses to various levels of nitrogen and other inorganic nutrients. Things finally jelled, and by the end of the academic year I wrote a thesis and underwent an oral exam to get my degree. Dr.

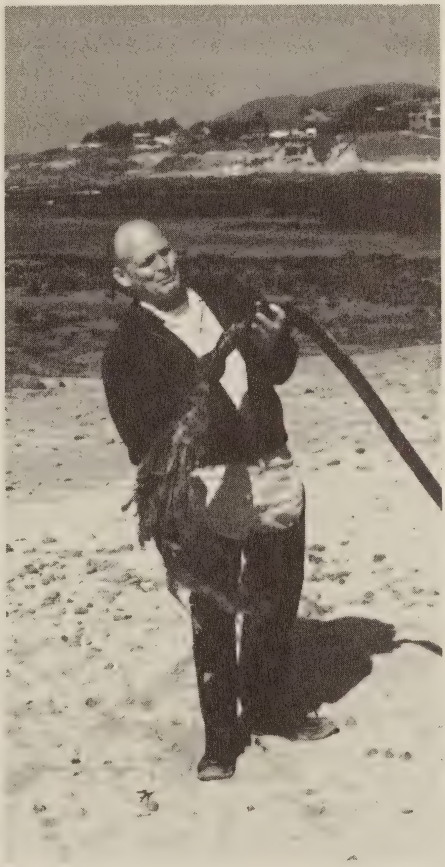
Thiers was tremendous in the help he provided, even though he was far from an expert on fern gametophytes.

In the fall, I took his mycology course, in which the labs were superbly full and well-organized--a multipaged guide for each lab. The spring phycology course was another matter. Dr. Oberlander was nowhere around, so it fell to Dr. Thiers to teach the phycology course that spring. It was a joy! I have never enjoyed a course as much. Dr. Thiers gave the standard lectures, but the labs were for us to identify and learn about as many freshwater algae, and then marine algae, as possible. And I still feel that identifying organisms is a wonderful way to learn about them. Well, that phycology course in the spring of 1961 convinced me, without question, that I was destined to become a phycologist. In fact, unless my memory fails me, I think that it was when Dr. Thiers took the class on a field trip to Monterey that I got irreversibly turned-on to marine algae. That is where I still am today, 27 years later. [Bill Johansen]

* * * * * * * * *

In the fall 1961, Harry Thiers, two graduate students, and the mycology class made a weekend field trip to Jackson State Forest in Mendocino. Through the kindness of the California Division of Forestry, Harry and his students stayed in a wooden ramshackle building at the old fire station on Little Lake Road. The wooden facility consisted of a large dormitory-like room, a rustic washroom, and a large kitchen. I have fond memories of the kitchen for it was there that we would put out our collections on a wooden table and review identifications together. Harry would answer all of our questions with patience and would repeat the answers as often as necessary. It was in that room that he was the ultimate teacher; an enthusiastic and wonderfully invigorating person.

One of the most memorable experiences with Harry happened in the dormitory. Each side of the dormitory was lined with metal bunks-- two bunks to a tier--each bunk with metal springs that had absolutely no give to them, and a nearly non-existent, thin, hard, bumpy mattress. In that room, Harry and all of his students would roll out their sleeping bags on



Demonstration of wave action on *Nereocystis*.

those bunks. One of our most favorite pastimes was to collect mushrooms after dinner by flashlight in the dark. After one such lovely collecting trip during which we had spent the evening becoming exhilarated by the sights of the gloriously shaped and beautifully colored mushrooms illuminated in the night by flashlight, we returned to the fire station in a festive mood. We had been kidding Harry the entire evening and he was giving as much as he was taking; however, we thought we were getting the upper hand. After we returned, Harry went to the kitchen, so I decided to take this golden opportunity to collect at least 100 Douglas Fir cones and put them inside Harry's sleeping bag. All of the students knew what was happening and as a group we decided to really badger Harry, including throwing Russulas at him in the kitchen. Eventually all became quiet and all retired to bed; of course with Harry the last to arrive. In silent anticipation, we waited for Harry's response as he climbed into his sleeping bag full of cones. All of us shouted gleefully as Harry let out numerous loud, uncommonly used verbs after getting into his bag. We all laughed uncontrollably as he got up and proceeded to empty his bag outside. Eventually it became sufficiently calm to go to sleep. I was snuggled deep in my bag with the top pulled over my head when at two o'clock I was unceremoniously shoved into the bottom of my bag as someone proceeded to lift the bag into the air with me still inside. I struggled frantically but to no avail and felt myself thrown into the air and then landing with a thud on some branches. After about five minutes of vigorous struggling to get out of my bag, I finally extricated myself. All of the time there was this furious uproar from inside the dormitory. As I looked up into the window through which I was thrown, the first person I saw was Harry Thiers, the person who had picked me up and thrown me out the window. With a jovial laugh and a twinkle in his eye, Harry said, "See, Dave, I told you I would get you back!" [David L. Largent] (Now we know why HDT later chose to sleep in his car. Eds.)

* * * * * *

I had just returned to San Francisco for Fall registration in 1961 and was informed that I needed an upper division elective in Botany as a graduation requirement in Biological Sciences. I didn't view this as a critical career decision because the main career tracks at S.F. State College were elementary and secondary education. Holding to my undergraduate view that nothing should interfere with afternoon athletic practice, I signed on for Mycology because it was offered in the morning and my other option wasn't. At our first class meeting, I sensed something was different about this group. Not only were the two graduate assistants (David Largent and Harriet Burge) absolutely 'lunatic fringe' about the fungi, but some of those taking the course (*e.g.*, Jerry Motta) were similarly afflicted and had been preparing months in advance. Fortunately for me, HDT knew how to guide the rookies while continuing to challenge the 'fringe.' Classwork lost the dimension of time. By November, when our Cross Country team won the Far Western Conference Championship at Reno, Nevada, there I was exposing Martin's Rose Bengal agar plates for airborne fungal spores at the Washo County golf course. My teammates played a practical joke by placing rabbit dung in some of the plates, a sign of things to come.

That winter, as rains came to northern California, the mushroom collecting assignments began in earnest. Two women in HDT's life, Ellen and Barbara (age 6, then), were present for many of the local collecting trips. Barbara could accurately name, to species, the different mushrooms we struggled to identify using taxonomic keys. Ellen collected various cryptogams of interest and worked in the Herbarium across the hall. How very thoughtful were Ellen's efforts at providing refreshments for special occasions. This class was becoming a family. It soon became apparent to me that HDT's extended family was also around evenings and weekends. This was not the 9-5 world of my parents and neighbors. HDT didn't play college professor, he lived it.

As other memories fade, one event remains fixed in my mind. Mendocino was the big December collecting trip and HDT guaranteed that we would complete our required collections of fleshy fungi. The drive was several hours duration and we arrived well after nightfall. Sleeping bags, collection baskets, drying racks, and kitchen supplies were unloaded and I looked around for a bunk. Then at 9:30 PM, the 'fringe' got out their flashlights and went outside to collect mushrooms. In a few minutes, they returned with dozens of *Laccaria laccata* that were found fruiting on the forestry station grounds. David Malloch (then a music major) and I shared a similar look of disbelief. Come on now, how could anyone be that hooked on the fungi? [Donald T. Wicklow]

* * * * * *

My first contact with Harry was as a very unsuccessful undergraduate student taking my first botany course in my senior year. As usual, I was starting the year off in a new major and found that as a prospective, if somewhat unenthusiastic, entomologist, I was required to take botany. BOTANY!! Of all the balderdash that I might be subjected to, I could not figure out why I needed botany. To my surprise, botany, as presented by Harry Thiers, was the most interesting course I ever took. Harry actually singled me out and invited me to go with the mycology class on a weekend field trip to Mendocino, which, along with other later Thiersians, converted me to mycology. The field trip was especially notable for the quantity of fungi encountered and Harry's unbounded enthusiasm for them. This field trip was also notable because it was the weekend that a well-known organization of mycophiles discovered the bounties of Mendocino. As the members of this club gleefully filled the trunks of their cars with mushrooms, Harry speculated out loud on a number of topics relating to this discovery.

Later I was tied down by an evening and weekend job and could not attend these wonderful outings. Instead, I absorbed what I could in the lab, which of course, was much. I discovered that Harry could not remove a glass of water inverted on the table near his manuscript on boletes without removing all of the papers and then spilling the water. It was a fascinating discovery until I found that he seemed to have no ability whatsoever for preserving marine algae, and instead, stored these on *my* desk next to *my* notes.

In spite of this inability to properly dispose of algae, he was remarkably able to identify such things; indeed, he was able to identify algae, mosses, lichens, various sorts of vascular cryptogams as well as a long list of fungi. This indiscriminate interest in all sorts of cryptogams rubbed off on his students, including me, and sentenced most to a lifetime of teaching lower division classes that botanists usually avoid because of their more modern specialized training. A sentence maybe, but with Harry as a model, something of a challenge as well....and maybe even a reward. I hold Harry directly responsible for the fact that I get to spend two wonderful weeks each August in New Brunswick teaching Marine Biology while my colleagues at home are attending the year's first staff meetings.

Staff meetings.......who of Harry's students can forget Harry after he had been to a staff meeting? Red faced, breathing rapidly and muttering epithets to himself or muttering epithets loudly to any student who was foolish enough to confront him. After a staff meeting, his rate of speech increased several-fold. Lectures that normally lasted an hour could be delivered in 20 minutes, pictures and all, and thus had to be followed by the next day's lecture to fill in the time. This could possibly have been avoided if we had asked a lot of questions, but who would have dared ask Harry a lot of questions after a staff meeting? There was at the time, a pear-shaped boy, who *did* ask questions at the wrong time and sometimes bore the brunt of the after-meeting effusions. This was the same kid who had his mother phone Harry to check out the dangers inherent in going to Mendocino and who finally upset the authorities to the extent that they threatened withdrawal of cooperation. This kid bothered Harry more than the one who cruised rapidly up and down the main street of Mendocino in a flatulent Volvo with SFSC boldly written on the back window.

All of Harry's students have such recollections and fond memories. From San Francisco they have gone out into the world and have maintained, consciously and unconsciously, the spirit they received from him. They remain a close-knit group that reassembles whenever possible to exchange the stories, experiences and knowledge that they possess because of their short time with this man. I am grateful and proud to be a member of this exclusive club. [David Malloch]

* * * * * *

In 1964, as a biology major in my junior year at SF State, I enrolled in a class called Cryptogamic Botany. I am pretty sure I had no idea what a "cryptogamic" was, but with the real and imagined demands on my time, I fit classes into available time slots. It was there that I first experienced Harry D. Thiers, seductive master of the well-planned lecture. He almost never used notes. I recall one time when he actually apologized for their use, while extracting a single 3 by 5 notecard from his shirt pocket, notations on one side only.

Harry also commanded amazingly interesting laboratories; the aura of which I struggle to attain in my own classes today. Components of the essential ambiance include somewhat untidy conditions created by stray lichen fragments, crumbled sheets of waxed-paper and discreet mounds of woodland debris, as well as the lingering fragrance of drying mushrooms; but most importantly, the drama of discovery was always present.

For me, there are many characteristics which comprise the image of HDT. The most compelling, and the one that establishes him as a world class mentor, is the natural ease with which he makes plants alive and students important. [William Paul Jordan]

* * * * * *

It is important and valuable to reflect, from time to time, on how one began his professional career. Certainly for a researcher and/or teacher, or any other professional, there are several factors to consider and weigh, one against the other, in determining just how it is that the present situation came about. Typically, a person is influenced by one, or perhaps a few outstanding individuals, who he has encountered during his early years.

For myself, I can say with certainty, that Harry D. Thiers was most influential in my becoming a teacher and a researcher. He was among the best teachers that I had as a university student, and his enthusiasm for learning, and teaching others, greatly influenced my decision to become a teacher. He also was my first adviser at San Francisco State. I am exceedingly grateful to Harry for his influence and guidance during my years at SFSU!

Harry Thiers introduced me to mushrooms and his area of research, even though I was not "officially" one of his students. He even selected the genus *Cortinarius* for me to work on. A genus that I have been struggling with for some twenty years, and something for which I will never forgive him!

It happened something like this: When I was an undergraduate student in Biology, I asked Dr. Thiers if I could informally attend his mushroom taxonomy course to learn a few basic things about fleshy fungi and absorb a few mushroom names. Of course, he said that would be fine. Actually, I was intimidated by the mushrooms, the seemingly knowledgeable graduate students, and even Professor Thiers himself. I learned a few names, somewhat slowly I admit, and realized very quickly that these organisms were indeed poorly known and difficult to identify.

During the class, I heard something about mushroom descriptions and how important they were in making a final and correct determination of a collection. So I decided to ask Professor Thiers how to prepare one. He quickly and efficiently got the idea of a mushroom description across to me, but it wasn't until the following summer, when I was in Idaho, that I actually tried to write a description of my own. Looking at my notes from that period clearly shows that they are practically useless. However, it did get me interested in mushroom taxonomy, and so I decided to try and write a few more descriptions to improve my skills.

An approach that seemed logical to me at the time, was to work on one genus for awhile, and then on another, to learn something about each one. So I went to Professor Thiers and asked him which genus might be a good one to start with in terms of doing descriptions. Of course, I made it clear to him that I would do this as a learning experience, and that he could have the collections and notes if they were useful. He agreed that this was a good idea. He thought about an appropriate genus for a few seconds, and then, with that characteristic smile on his face and more than ample encouragement (I should have been suspicious), he quickly suggested the genus *Cortinarius* as a starting point. He said there were a lot of them around (a true statement) and that it would be helpful to him if I wrote up some of the collections. I agreed to get started at the first opportunity. Twenty years and some hundreds of descriptions later, I'm still working on *Cortinarius* and the closely related genus *Dermocybe*! Actually, I enjoy it very much and I am exceedingly thankful to Harry Thiers for keeping me busy all these years. [Joseph F. Ammirati]

* * * * * *

Unlike many college freshmen who vacillate between majors from semester to semester, my decision had been made several years before I stood in line on that first registration day at San Francisco State College. My plan was to eventually lead me to a career in high school teaching, that is until I met Harry Thiers.

My first, and probably most memorable course, from Harry was Cryptogamic Botany. I can remember being somewhat apprehensive about being in this class, probably for two reasons: first, I had heard from other students that Dr. Thiers was a demanding teacher, and secondly, my older brother Don was also in the class. For the first week he wore a perpetually worried look, certain I was going to say or do something to embarrass the family name! As that semester went on, my apprehension turned to confidence and it became clear that my plan was changing and that I was going to do many more botany courses. Harry has a way of making each student feel important and unique. He is an unmerciful tease, a generous teacher, and a kind, thoughtful human being.

The field trips, especially the weekend trips, have to be the most memorable part of any Thiers course. In particular, I remember Jackson State Forest in Mendocino where we collected mushrooms at spots known as "Mushroom Corners," "*Aleuria* Glen," and "*Amanita* Avenue," stayed in an old wooden dormitory affectionately called "The Villa," and shopped for food in the village of Mendocino at a little market called Mendoza's. Harry was at his best on these trips; leading forays, reviewing his collections, "supervising" the shopping, answering questions, "arguing" with his graduate students, helping with identifications, harassing the cooks, teasing us for our mistakes, appreciating our individuality, and encouraging our successes.

Dr. Harry Thiers nurtured our interest in the living world, shared with us his wonder of learning, and taught us with energy, humor, and commitment, and because of that our lives have been forever enhanced. [Marcia Wicklow-Howard]

* * * * * *

I first attended San Francisco State University in 1965. Shortly thereafter I took my first course from Dr. Thiers on the recommendation of several other students. I was overwhelmed with Dr. Thiers' enthusiasm and knowledge of the subject material as well as his personal interest in all of his students. We all felt that we were special and that our education was very important to him. My feelings may have been somewhat influenced by his somewhat unethical approach of bribing his students with cookies and other treats during class meetings.

One area of concern to all students is grades. Dr. Thiers shared that concern with his students. His exams were fair and straightforward, no trick questions. This approach allowed us to be more relaxed and able to present more of our knowledge of the subject material. His evaluations took into account individual weaknesses. This special caring helped many of us develop the academic foundation to continue our education. I am sure that without his overwhelming support and guidance some of us would not have gone on to accomplish as much as we did. For this I am truly indebted to Dr. Thiers.

The most enjoyable years of my life were spent at San Francisco State University as Dr. Thiers' student. The herbarium life was wonderful - open 24 hours a day. It seemed like Dr. Thiers was always there. I am sure this could be substantiated by Ellen Thiers. The academic environment and the camaraderie in the herbarium that existed among a wonderful group of graduate students will always be with us. Thank you Dr. Thiers for a true quality education. [Bob Keller]

* * * * * *

I was 21 and in my junior year at San Francisco State when I met Dr. Thiers. He taught a general botany course which I had taken to satisfy a college requirement. Dr. Thiers taught the course many times, but when he lectured, he made me feel as though it were the first time he was sharing the information with a class. His approach was enthusiastic. When he talked of various organisms, "curious" was a term he often used to describe them. Curious is exactly what I became.

His approach in lecturing was clear and scholarly, and his approach towards the students was friendly and encouraging. He encouraged questions and answered even the most elementary ones without belittling the student. He knew when a student was struggling and made himself available for help. Except when teaching classes, Dr. Thiers was in his office actively working on research and keeping abreast of the changes in his field. His door was open, and he was never too busy to talk with his students. He would counsel, encourage, and listen.

At the end of the semester of general botany, I changed my major from German to biology. I took several other courses from Dr. Thiers, each time finding them challenging and enjoyable. I have gone on to pursue the study of plants professionally. Without the enthusiasms and encouragement of Dr. Thiers, I might not have entered the field in which I have been so successful. [Barbara Keller]

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My first introduction to Dr. Harry Thiers was in the fall of 1972. At the time, I was not a student at SFSU, but my husband, Jim, was taking General Botany from Dr. Post. That semester, a botany retreat was held at Mendocino Woodlands and I tagged along. Since it was my first exposure to mushrooms, it seemed as though every time I turned around, there were 10 more new mushrooms. I followed Dr. Thiers all weekend trying to absorb all the names and characteristics. I was very impressed with all the information there was to learn about each mushroom, besides whether or not it was edible! The beauty of these organisms was overwhelming - it was better than an Easter egg hunt. Eventually, I participated in countless more cryptogamic forays as an undergraduate, and then as a graduate student at SFSU under Harry Thiers. Now, long after finishing school, I still spend much of my free time botanizing and greatly appreciate being able to tag along with Dr. Thiers and his students, and all the while still learn from this wonderful man. [Mona Bourell]

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As a new undergraduate at San Francisco State, I well remember HDT's enthusiasm for mycology, and for the teaching of it. Harry was generally patient and generous with us as we struggled with esoterica which were second nature to him. I remember that he could also be gruff, at least in response to "whippersnapperisms," my term for the awkwardly inappropriate remarks I seemed to be able to make all too frequently and obliviously.

When the chips were down though, Harry was unfailingly gracious and supportive. There were the lesser tragedies, such as our trying to clean the laboratory glassware after semester's end. If we had asked how to operate the dishwasher properly, we probably would not have created the hurricane that pulverized a great quantity of HDT's dearly-bought labware. But then it would not have been a surprise. He took it all in stride.

A larger tragedy than an electrical fire in a herbarium drier should not even be contemplated. I experienced such a fire, which, in addition to seriously damaging the Biology building, destroyed about one third of my research collections and field notes, as well as material on loan from the New York Botanical Garden. For 90 hideous minutes, we thought that all the western *Agaricus* holotypes might have vaporized. After the dust settled, Harry scraped my ego off the basement floor and gave me a major pep talk that helped me decide to stay in the game.

Small goofs were usually digested relatively easily. I guess we forgot to tell HDT we were fixing a Mexican-style breakfast one morning at the Branscombe reserve. I didn't know anyone could mistake salsa picante for strawberry jam, but I do now. I believe he ate the entire English muffin anyway, after that first poignant, pungent realization.

There were other moments of grace under stress (his or mine), too numerous to mention here. If you know HDT at all you can imagine them as well as I could relate them. Well, I do remember one gruff response I provoked after complaining one time too many, that the *Agaricus* keys with which he had furnished us were miserable and useless testaments to human folly and ineptitude. "Well," he said, or rather glowered, "if you think that *you* can do better, then by all means be my guest." Or words to that effect. I like to think I spied a crafty glint behind that stern visage. I don't so much mind being conned, but there are times when I wished I'd complained about a different genus. [Rick Kerrigan]

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As with many other students of Harry Thiers, I'm one of those who will never forget my first field trip with him. After my first five days in graduate school at SFSU, I was invited, along with two other students, to show up on Saturday morning in front of the Biology Building at 6:00 AM ready for a collecting trip to the Sierra Nevada. Much to my chagrin, my alarm clock failed me, and after a five minute sprint (with basket on arm) from the dorm to the designated rendezvous, I found HDT pacing Holloway Avenue like an expectant father. After minor harassment, we were underway in HDT's VW camper. Taking my duty as "shotgun rider" nonchalantly, I quickly learned not to offer hot coffee and sweet rolls to the driver (Harry) until after the Livermore interchange. Unfortunately, by the time we reached Livermore, the coffee was nearly gone and the sweet rolls were but a fond memory to us students. At this point, HDT initiated a pointed discussion about graduate student eating habits, whereupon our destination (Silver Lake Campground) seemed several lightyears distant. Having chosen as a thesis project to work on Sierra Nevada boletes (a wise move I thought), I believed I now could redeem my tardiness and gluttony by showing my vast knowledge of Sierran boletes. After five minutes collecting, I soon realized that *Boletus rubripes* was not *B. edulis*, *Gastroboletus turbinatus* was not diseased, and that I should never again let myself be tricked into tasting *B. calopus*. When HDT made the suggestion to return to the car for lunch, I felt some relief. Finally, I thought, something I know how to do. On the way from the car to the picnic table, however, I dropped the jar of mustard (Grey Poupon no less) on the asphalt parking lot, prompting comments about the usefulness and qualities of today's graduate students, and instigating instant flashbacks of all my previous blunders that day. Extraordinary caution the rest of the trip prevented further damage to my bruised ego. Nevertheless, I felt challenged.

During the next two years, there were many more trips, especially to Silver Lake. These were times that I remember fondly and believe I was particularly lucky to have a chance to benefit from HDT's expertise in the field. His jesting that demanded rebuttal, frankness, enthusiasm, and overwhelming interest in a student's welfare inspired confidence to meet the challenges. Fortunately, I learned, among other things more academic, the appropriate times for drinking coffee and eating pastry in the car. [Roy E. Halling]

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Supervising the collection of hypogeous fungi near Yuba Pass.

I recently returned to visit SFSU 10 years after receiving my Master's degree under Dr. Harry Thiers. As I drove to the campus, it appeared that nothing had changed in those intervening years. I parked my car in the same place I had always parked it and felt distinctly odd not carrying any books as I walked to the Botany building. To reach the graduate student desks in the herbarium, one must walk through a complex maze of herbarium cases which I found I could still negotiate on remote control. I have such a strong association with the aroma of naphthalene and dried mushrooms from my student days that it seemed as though each case I passed removed one of the last 10 years.

The arrangement of the herbarium was exactly as when I'd been there, and my old desk was in its same place - I almost walked over and sat at it. Not only that, but nicknacks from a party 12 years ago were still decorating the room. Dr. Thiers has always been famous for the annual Christmas and end-of-the-year parties. One holiday season, we were required to make a gift to exchange with another graduate student. The only requirement was that it be made out of cryptogams. With the imagination typical of graduate students, we all went to work on these projects. The results ranged from freeze-dried mushroom arrangements to bracelets made out of *Lactarius subdulcis* to a mobile made out of lichens and mosses. The mobile is still tacked to the ceiling with a thumb tack!

Dr. Thiers was also the same as ever; warm, friendly, welcoming and always ready with a joke or a mildly sarcastic quip. The first time Dr. Thiers teases a new student is like a rite of passage or the beginning of acceptance in the ranks of grad students. He used to tease George Wong for sleeping at his desk, Janelle Curlin for her diminutive stature and I got it once when we were going on a trip in northern California. Another student and I were driving together and missed the turnoff. We didn't notice that we'd gone too far until we saw the "Welcome to Oregon" sign. This gave HDT sufficient fuel for teasing to last several days. For some reason, Roy Halling was labelled the "penultimate authority" during his time at State. Dr. Thiers was always quick to emphasize the *pen*ultimate nature of it. When a beginning student asked HDT for identification of some common mushrooms, he'd often say to take those to the penultimate authority and he *might* know what they were.

Another major source of memories from SFSU were the numerous field trips and forays we took. We covered nearly every part of California, and beyond, in search of fungi, mosses, lichens and higher plants. As long as I've known Dr. Thiers, his expectations of students always seemed equitable, regardless of gender, when it came to setting up tents, cooking, building fires or hiking over any kind of terrain in search of the elusive mushroom. I look back very fondly on the years I spent studying under the exceptional guidance of Dr. Thiers. [Betty K. Tamm]

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I wonder if any one of us knew, as we luxuriated amidst the incredibly rich labs of Dr. Thiers' classes, just how many levels of learning there were. I had no idea until I began to teach labs myself at the University. There I poured over his class notes, read and reread his marvelous lab handouts and slowly began to understand what an extraordinary education had been mine. Everything was organized around a deceptively simple formula: compare, contrast, synthesize. This was a formula for learning and it was also a formula for teaching. Now I understand why so many of us later taught. That is what HDT meant for us to do. He was never selfish with his vast knowledge and he did not mean for us to be selfish.

The openness and generosity that HDT showed his students extended to other teachers and researchers as well. I look on my hours in the herbarium as the most intellectually stimulating time of my life to date. Dr. Thiers' bottomless coffee urn drew students and professors studying bees, butterflies, ecology, algae, plant chemistry, bryophytes and more. The list is a long one. It was in the herbarium that I learned about open sharing of ideas, frank admission of research problems, and to see the relatedness of all the natural sciences. Sharing, not secrecy, was the power of the herbarium. "When my students win, I win," he often said. HDT brought the great names in the field to our herbarium gatherings to share their knowledge, discuss our work and often contribute to our bulging herbarium.

Now I understand how important it is for a teacher to respect students, for students to be taught to respect each other, and the power of humility in the face of greatness. HDT's philosophy of life has stayed with me as surely as his beautiful labs in pathology, lichenology, lower vascular plants, mushrooms and soil fungi. It is a rich inheritance. Thank you, Sir. [Janelle M. Curlin]

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One morning in 1978 as a middle-aged reentry student working towards a masters in biology, I found myself in a large general botany lecture hall. I was much impressed with the energy and enthusiasm of the professor, Dr. Harry Thiers, and thought to myself, "Wow! This guy must have been teaching this subject for 20 or 30 years and yet he still makes non-vascular plants sound like the best things that ever happened. And at eight o'clock in the morning!"

A year later, I had a desk in the herbarium and was one of Harry Thiers' graduate students, specializing in lichenology. It was a privilege to enter into this association. The atmosphere in the herbarium was unique. There was much hard work, great field trips, fine parties, and Harry Thiers always present to help with our questions and problems. He was incredibly generous with his time, talents, and equipment. At the same time, he encouraged and prodded each of his students to accomplish as much as possible, largely by example. Thank you, Harry, for the "Herbarium Experience." [Janet Hoare Doell]

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A course taken from Dr. Thiers is a course never to be forgotten. Each one has at least one field trip; usually there are four or more. Such a wealth of information, and presented in such an interesting and organized manner, his teaching abilities are beyond comparison. Not only in the classroom, but in the field, this man is full of unique knowledge as well as wonder and a yearning to discover more. Anyone who has had the pleasure to spend some time with Dr. Thiers, knows this is easily bestowed upon them. Whether it be in Marin, Sonoma, Mendocino, Humboldt, Del Norte, Siskiyou, Shasta, Sierra, Santa Clara, Santa Cruz, San Mateo, or San Francisco Counties in California, or perhaps another state, the experience is always greatly enhanced by his generosity and enthusiasm.

He has such wonderful stories from years past taking place in Michigan, Montana, Idaho, Arizona, Texas, and the southern U.S. I wish I had taped these during his lectures. Though I may never get to one, I will always know how to walk in a *Sphagnum* bog after his brilliant demonstration!

As can be seen from this volume, Harry Thiers' contribution to mycology is enormous, invaluable, and something to be so proud of. And finally his contribution to education is noteworthy, whereby many of his former students have gone on to be fine teachers. [Michelle Seidl]

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I first met Dr. Harry D. Thiers in the fall of 1973 while he was engaged in the identification of mushrooms for the Mycological Society of San Francisco's fungus fair. Early the following year, I signed up for an evening class Harry offered to members of the mycological society who were interested in learning the technical ins and outs of mushroom identification. I soon discovered, via this informal class, Harry's gifted teaching talents, and his tremendously vast knowledge of fungi. Although our class only met for a few hours once a month, my guided discovery and fascination with the microscopic features of fungi quickly led to the purchase of a microscope and a number of technical monographs.

It was not until the spring of 1982 that I took the first formal course from Harry through the San Francisco State University extension system. This course, "Higher Fungi of the Sierra Nevada," first offered in June 1982, was held at San Francisco State's Sierra Nevada Field Station, near Yuba Pass, California. The course was attended by about 20 students, including Dr. Walter Sundberg, Dr. Andrew Methven, Dennis Desjardin, and Janelle Curlin, all of whom were either past or current students of Dr. Thiers. By the end of the week, our class had collected and identified some 220 species associated with the melting snowbanks and spring runoff in the Yuba Pass region. It was through this class that I got my first real taste of mycological taxonomy and encountered the tremendous pleasure of discovering the fascinating realm of the snowbank fungi. Harry continued to teach this class up through June 1987, finishing with a class size of just over 40 students.

In January 1985, through a fortuitous change in jobs, I was able to re-enter college, and begin a course of study under Harry's guidance. Admitted as a junior, I was able to attend full time for only the first semester. That summer, after Harry's class at Yuba Pass, I found another job which would allow me to continue as a part time student, while working full time to support my family. Aware that Harry was to retire in January 1989, I knew that I would need to take all of his courses quickly if I was to fit them in my schedule prior to his retirement. I feel fortunate indeed that I have been able to complete all of the classes that he offered during this time, and am particularly grateful to Harry for rescheduling some of these classes to meet during hours which I could attend.

Harry takes a great deal of pride in each of his students, following their varied careers with interest and enthusiasm. His prior students often visit, write or call him to chat about current projects, career moves, etc. just to keep in touch. His correspondence desk has a transparent cover under which he keeps a large number of photographs of his students and close associates. He even hosts an annual reunion dinner for his prior students each summer at the MSA meetings. I see him react not unlike a father to many of his students, giving advice, guidance and direction when called for, providing a strong foundation upon which to build a future career. He often displays prominently in the herbarium letters from his former students for the current crop of botany students and staff to read, so that they too feel as part of his family. I am proud to have Harry as a very respected friend, and feel fortunate that he has played a major role in my life and education. [Herb Saylor]

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Sharing the laboratory with Harry D. Thiers is an integral part of the experience of an education in taxonomy. Dr. Thiers is a sight to behold, especially when he is working on taxonomic projects. I have had the privilege of observing him during his most recent endeavor with California Russulas. Nothing pleases Harry more than a drier full of specimens, spore prints already made, and preliminary notes written. The initial result of a successful collecting trip is an herbarium full of discarded wax bags, and assorted debris scattered on counter tops and the floor. The atmosphere in the herbarium at this point reflects Harry's expansive mood. Later, when his microscopy starts in earnest, he becomes a different man. Quiet studiousness reigns during these weeks, while he buries himself in the wide, unforgiving bosom of his oculars. "Got six done this afternoon!" indicates a moderately good session. "Why don't you give up those Cladonias of yours?" is a playful statement of his own frustration, and a challenge to spar. "I've got to go down to the bank," or more ominously, "Take a look at how neat everything is down at my end [of the herbarium]!" portends a struggle with intransigent pleurocystidia or spore ornamentation. Following a major cleaning session, during which the shelves holding *Mycologia* or *The Bryologist* are meticulously put in order and lined up, correspondence conquered, and reprints filed, the herbarium is slowly emptied of talkative students. Not until Dr. Thiers has safely returned to his microscope do the students filter back in.

Despite his immense objectivity and scientific discipline, Harry has been known to reflect on a few of his major successes. One of these is that he convinced Alex Smith of the phylogenetic significance of hypogeous fungi in the Sierra Nevada. Another source of pride is his mycologist's sense of smell and taste; the "green corn" [pronounced *'carn'* until recently -Eds.] odor is known to all his students. I can boast of a minor accomplishment in this realm, convincing Harry that he can smell atranorin in certain lichen species.

Some ways born of a harsh west-Texas boyhood die hard. Five o'clock marks the suspension of all work, be it in the field or laboratory, for the requisite happy hour. An hour or two of relaxation is inevitably balanced by a return to work. Nights find Dr. Thiers burning the candle until at least nine or ten PM. Even on damp field trips to Patrick's Point State Park or Jackson State Forest, he finds an empty picnic bench after dinner to set up his specimens for spore prints.

His late afternoon sabbatical works in tandem with another habitude, the extension of warm and heartfelt hospitality to all who enter the herbarium. While I worked at SFSU with Harry Thiers, people from all parts of the world were welcomed and assisted in their scientific pursuits. This marks the greatest quality of Harry as a taxonomist and teacher: his desire and ability to share with others. His sense of wonder, curiosity, and generosity continue to benefit all who cross his path. [Samuel Hammer]

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Discussing collecting strategy at Yuba Pass.

REMEMBERING THE MOREL GROWER: RON OWER, 1939-1986

Ronald Dean Ower was born on 15 May 1939, and died on 23 March 1986, victim of a murder-robbery. Ron was a long-time member of the San Francisco Mycological Society, who, after selling his sign-painting business, became a graduate student of Harry Thiers at San Francisco State University in the fall of 1977. He wanted to grow morels (*Morchella esculenta* L.) in artificial culture, and this was the topic of his master's degree research. He was not successful in inducing his cultures to fruit during the course of thesis work, which he concluded in the spring of 1980 with a thesis entitled "Cultural studies of morels". However, after completion of his degree, Ron was permitted to continue his culture work at the University. On 14 December 1980, he first detected the development of ascocarps that later developed to maturity. These were subsequently harvested on 11 January 1981, and deposited in the San Francisco State University Herbarium (SFSU). After duplicating his results, he published a brief article on the achievement: Notes on the Development of the Morel Ascocarp: *Morchella esculenta*, Mycologia 74: 142-143. 1982.

Ron then began work on scaling up his technique, in order to develop commercially viable cultivation. He entered into an association with Neogen Corporation, a biotechnology firm in Lansing founded by Michigan State University in 1982. On 17 June 1986, a federal patent was granted to Neogen (Patent #4,594,804) for the "Cultivation of *Morchella*." Ron Ower was credited with development of the technique. Tragically, he died three months before the patent was granted. The following are recollections about Ron and his work by three students of Harry Thiers who were contemporaries. [Barbara M. Thiers].

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I remember Ron's first spring with Dr. Thiers as a time when Ron frequently would be out in the field, camping in some likely but frigid spot, waiting for the first *Morchella* primordia to appear. It was apparent that Ron's approach to understanding reproductive initiation in *Morchella* was to be thoroughly familiar with the natural history of the phenomenon. To this end he assiduously applied himself, and we saw rather little of him for several weeks. I could tell before arriving at the herbarium whether he had returned from such an expedition; he and I parked in the same peripheral sector of the SFSU environs, and one could not miss the large signs for the "Morchella Co." which adorned the doors of his truck. He would show us what, if anything, he had found, and make taxonomic predictions about it, before setting to work on culturing the new material.

As his work progressed he shifted his focus to laboratory work. He explored the genetics of sexuality in *Morchella* with the help of a micromanipulator, spending long hours on "ascus stroking," as he called it. He explored anamorph-teleomorph connections in these organisms, but did not submit his findings when a similar report appeared in the literature. Most of his later work at SFSU focused on cultural techniques for inducing reproductive growth in *Morchella* under controlled conditions, and, as is well known, he was the first to succeed in achieving this. Subsequently he explored the morphology of the developing ascoma of the morel.

Ron Ower was somewhat of an enigma to me. He could at times be surprisingly candid, while at others he was very reserved. From the outset of his research career at SFSU he realized the commercial potential of his research objectives; as a result he became less communicative over time, to the point where I couldn't say I knew his personal or professional side very well. By that time I was employed in the commercial mushroom industry, at one point with a firm who was negotiating with Ron for rights to his morel-growing process, which explains why Ron may have experienced a conflict as regards the nature of our communications.

I remember Ron as a relaxed and genial individual, never the center of attention, almost playful in his approach to social behavior and to life in general. When one was aware of his presence he was usually make some positive contribution to a conversation in the herbarium or a meal on a field trip. He accomplished his initial scientific objective of fruiting the morel, and after years of effort he also met with reasonable financial success in exploiting the commercial aspects of his process. I last spoke with him about a year before his death when he referred to the continuing experiments on *Morchella* culture that he was conducting in his small private laboratory in San Francisco. He was intrigued and optimistic. [Richard W. Kerrigan]

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I was obsessive about cleanliness. Ron thought that was a waste of time. We shared a growth chamber. The combination could have been a disaster. Instead, it was fun and occasionally even exciting. Like the day Ron announced that wild morels did not fruit in sterilized soil, and that was probably why his were not fruiting. After that, my marine fungi shared their growth chamber with trays and trays of horse sweeping from Golden Gate Park, unautoclaved.

My marine fungi were never contaminated. Ron's morels fruited right on schedule for HDT's farewell party as he left for Australia on sabbatical.

Ron and I confided our fears of aging, poor memory, loneliness, and money troubles. He gave my various boyfriends nicknames. One I particularly remember was dubbed "Old Abe Lincoln." Our favorite conversation topic was HDT (of course). Ron said that two hours of conversation with HDT could provide him with weeks of good ideas. We tried to figure him out. Why was he so intellectually stimulating? Why did we all work so hard for him? How could we ever be like him? Did he really care as much as he seemed to? How could he get so much done on his own research when he spent so much time teaching? What was the secret of his encyclopedic memory? It was a topic we never tired of discussing.

My slide collection contains many slides of Ron and his collecting finds. He had a sixth sense in the field and not only for morels. I treasure those slides of a man who really enjoyed fungi and whose big smile conveyed his delight. [Janelle Curlin]

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Ron Ower sat facing me in the lichen lab and when I think of him I picture his very round eyes and open countenance. He was not enchanted with lichenology and especially disliked memorizing all the names, something he could not do well.

He was a conscientious student and tried valiantly to study each collection in detail. He was conscientious in other ways as well and it bothered him that his parents had to help support him while he was devoting so much time to his morel growing project. *That* was an interesting semester. We cheered at every 1/8 mm of growth, grieved over the ones that did not survive, and considered it an honor to be invited into the inner sanctum to take a peek.

However, he agonized in the succeeding weeks and months as he tried to turn his discovery into a livelihood. He was depressed more than once, but always grabbed eagerly at hopeful developments and was happy to talk about them whenever we ran into each other after graduation. He was adamant about not leaving San Francisco and that added to the difficulty of working out something in Michigan.

Ron was something of a loner. He enjoyed an occasional meal at our home, including holiday dinners, and rarely seemed to have other commitments. He was a gentle person. It is hard to imagine him suffering such a violent death. He deserved something much better. [Janet Hoare Doell]

Ronald Dean Ower: 1939-1986.

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DERMOCYBE, SUBGENUS DERMOCYBE, SECTION SANGUINEAE IN NORTHERN CALIFORNIA

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ABSTRACT

Five taxa in the genus Dermocybe, subgenus Dermocybe, section Sanguineae are fully described. These include D. sanguinea and D. semisanguinea; a new species, D. sierraensis; and two new combinations in Dermocybe, D. californica and D. phoenicea var. occidentalis. A key to these taxa is provided.

INTRODUCTION

In all earlier publications by the author Dermocybe was considered to be either a subgenus or section of Cortinarius. Here, Dermocybe is recognized as a genus with limits as defined in Singer (1986). In this paper only the section Sanguineae is treated. Furthermore, only those species recorded to date by the author from northern California are described below. A more extensive, but still incomplete treatment of section Sanguineae for North America, can be found in Ammirati and Smith (1984).

In this study all microscopical data was taken from sections or pieces of dried basidiomata which were mounted in a 3% aqueous solution of potassium hydroxide. Capitilized color notations are from Ridgway (1912). Uncapitilized color terms are regarded as useful approximations. Terms such as moderate reddish orange are from Kelly and Judd (1965). All cited collections are deposited in the San Francisco State University Herbarium (SFSU) unless otherwise noted by use of an abbreviation from Index Herbariorum.

BRIEF SYNOPSIS OF SECTION SANGUINEAE

Basidiomata small to medium sized; pileus surface silky to innately fibrillose, appressed fibrillose, or minutely squamulose, dry to moist, usually not hygrophanous or hygrophanous to subhygrophanous, color deep to rich red, purple-red, reddish brown to brownish orange, or less commonly yellow-brown to somewhat olive-brown; context thin to moderately thick; lamellae when young dark to rich red, purplish red, rich brownish red, reddish orange or brownish orange, rarely truely orange or yellow; stipe usually slender, equal or the base somewhat enlarged, silky to fibrillose, variously colored, often, but not always, concolorous with the pileus surface and lamellae; interhyphal pigment deposits often lacking, when present usually occurring as small deposits or particles; basidiomata rich in anthraquinonic pigments (see Keller and Ammirati, 1983); potassium hydroxide (3% aqueous solution) applied to pileus surface of fresh basidiomata dark red, purple-red, purple or blackish purple; basidiospores ornamented; cheilocystidia either present, and not well differentiated, or absent.

Type species: *Dermocybe sanguinea* (Wulf. : Fr.) Wünsche

KEY TO SPECIES AND VARIETIES

1. Pileus surface color usually yellow-brown to dark yellow-brown, at times more yellowish, orange-brown, or olive-brown; KOH (3% aqueous solution) instantly changing the pileus surface to purple or blackish purple when applied to fresh specimens; lamellae rich red to purple-red; stipe typically some shade of yellow, pinkish or reddish tones may be present on the base, and similarly colored fibrils may sparsely coat the surface . . . . **D. semisanguinea**

1. Basidiomata not as described above; pileus lamellae, and often (but not always) the stipe, purple, red, red-brown, orange-red or more orange in color . . . 2

2. Pileus surface color deep red to rich red or deep red-brown; lamellae deep purple-red to deep red or bright red; stipe ground color yellow to ochraceous to dingy buff, the stipe base similarly colored or

pinkish to reddish, and reddish to pale ferruginous red or brownish fibrils may or may not coat the stipe surface 3

2. Pileus, lamellae and stipe basically more or less concolorous when fresh, usually some shade of purple-red, red, or orange-red to brownish orange (yellowish to ochraceous colors may be present on the stipe base) 4

3. Stipe ground color some shade of yellow, base or surface fibrils may be colored reddish or pinkish . . . . **D. phoenicea** var. **occidentalis**

3. Stipe ground color more dingy buff, surface sparsely to more heavily coated with reddish fibrils . . . . . . see discussion under **D. phoenicea** var. **occidentalis**

4. Pileus surface appressed silky to silky fibrillose, hygrophanous or not hygrophanous, color reddish orange, reddish brown, brownish red-orange or brownish orange 5

4. Pileus surface appressed fibrillose to minutely squamulose, not hygrophanous, color deep red to rich red, vivid red or purple-red 6

5. Pileus surface appressed silky, more or less hygrophanous, color reddish brown to reddish orange, fading to brownish orange; stipe surface some shade of orange to reddish orange with a more or less concolorous base (often orange-red); basidiospores verrucose, 8-9.5 x 5-6 um in size . . . . . **D. californica**

5. Pileus surface silky to fibrillose, not hygrophonous, color brownish orange to brownish red-orange; stipe deep vinaceous to almost concolorous with pileus surface, base vinaceous not (yellowish or ochraceous); basidiospores verruculose, 7.5-9 (-9.5) x 5-5.5 (-6) um in size . . . . **D. sierraensis**

6. Pileus, stipe (except for base), and lamellae rich to deep red or blood red . . . . **D. sanguinea**

6. Pileus, stipe (except for base), and lamellae more vivid red to purple-red . . . . . see discussion under **D. sanguinea**

DESCRIPTIONS OF TAXA

Dermocybe californica (Smith) comb nov.

BASIONYM: Cortinarius californicus Smith, Contrib. Univ. Mich. Herb. 3:37-38. 1939.

PILEUS 16-85 mm broad, obtusely conic to companulate becoming broadly companulate, umbonate to broadly umbonate; margin typically decurved, appressed against the stipe at first; surface smooth, glabrous to appressed silky, more or less shiny, moist to dry, more or less hygrophanous, color moderate reddish brown (Bay, Hay's Russet) to dark reddish orange (Vinaceous Rufous) or strong brown (Kaiser Brown) at first, fading to brownish orange (Cinnamon Rufous), with the disc often remaining darker. Context moderately thick on the disc, watery at first, moist to dry, concolorous with surface of moist or faded pilei, often pale reddish ferruginous; odor and taste not distinctive or slightly fungoid-raphanoid.

LAMELLAE adnate becoming slightly adnexed, narrow to moderately broad (5-7 mm wide), often more or less ventricose, subdistant, color dark reddish orange to moderate reddish orange (English Red, Mars Orange) or deep orange (Orange Rufous) at first, becoming deep orange (Burnt Sienna) or ferruginous brown; edges long retaining the original color, fimbriate or slightly serrulate.

STIPE 50-150 (-200) mm long, 5-15 (-22) mm thick, the base often 10-20 mm thick, terete, equal or more frequently the base slightly enlarged to clavate, occasionally narrowed below; surface dry appressed silky or sparsely fibrillose, subshiny, color dull orange, dark reddish orange to moderate reddish orange (Ferruginous) or moderate orange (Flesh-Ochre), sometimes with orange fibrils from remains of cortina, basal mycelium often orange-red. Context solid becoming hollow, color pale moderate orange (pale Flesh-Ochre) to rusty red near the surface, unchanging. CORTINA profuse, fairly persistent, color pale moderate orange (pale Flesh-Ochre).

BASIDIOSPORES (7.4-) 8-9.5(-11) x (4.8-)5-5.8 (-7.0) um, in profile view elliptical to broadly elliptical, at times somewhat fusiform or more or less amygdaliform, in face view elliptical to broadly elliptical or fusiform, more or less verrucose, ornamentation coarser toward distal end, yellow-brown with darker brown ornamentation. BASIDIA 4-spored, 24.1-32.9 x 5.8-8.0 um, elongate-clavate to clavate or broadly clavate, hyaline to faintly purple or pinkish, often containing deep purple to red-purple granules, some containing brownish to yellow-brown pigment. PLEUROCYSTIDIA absent. CHEILOCYSTIDIA 21.9-38 x 6.6-13.1 um, more or less cylindrical to cylindrical-clavate, clavate, broadly clavate or somewhat ventricose, thin-walled, color similar to basidia, usually mixed with basidia but sometimes in groups. TRAMAL HYPHAE OF LAMELLAE subparallel, somewhat interwoven, 3.3-29.2 um wide, cylindrical to more or less inflated, hyaline to slightly pinkish or purplish, some containing purple, red-purple or pinkish purple granules. CUTICULAR HYPHAE OF PILEUS interwoven, more or less radially arranged, cylindrical to inflated, 3.7-26.5 um wide, in surface layer mostly 3.7-8.8 um, the broader, inflated hyphae more common in the subcuticular region (this often appears as a distinct hypodermium between the surface layer and trama), thin-walled, some encrusted, hyaline, yellowish, light brownish or yellowish brown in the surface layer, in the subcuticular region similar to tramal hyphae of pileus; no pileocystidia seen. TRAMAL HYPHAE OF PILEUS interwoven, more or less radially arranged, especially in upper trama, cylindrical to inflated, 5.1-29.2 um wide, color similar to tramal hyphae of lamellae. CLAMP CONNECTIONS of the normal or medallion type, present throughout the basidiomata. INTERHYPHAL PIGMENT DEPOSITS absent (some small interhyphal granules may be present but no large deposits).

Solitary or gregarious to caespitose in mixed hardwood-conifer and conifer forests; October into December.

COLLECTIONS EXAMINED. *California*. *Del Norte Co.*: B.F. Isaacs 506 (WTU); J.F. Ammirati 140, 141; A.H. Smith 8957 (holotype, MICH); H.D. Thiers 14308, 14496. *Humboldt Co.*: J.F. Ammirati 148. *Mendocino Co.*: J.F. Ammirati 717, 6185, and 6186, (both MICH); J. Motta ID 328; H.D. Thiers 9628, 18460, 21751, 30464, 30825, 33177, 35602, 40601; G. Wong 359. Siskiyou Co.: H.D. Thiers 46798. Tuolumne Co.: H.D. Thiers 46934. Yuba Co.: H.D. Thiers 47143.

Dermocybe californica is one of the most common and widespread species of section *Sanguineae* in Northern California. In general it occurs along the west coast from California into Canada and east as far as northern Idaho.

Its overall coloration (reddish brown, reddish orange, brownish orange), more or less silky, usually hygrophanous pileus, and coarsely ornamented basidiospores, easily separate it from all other Sanguineae. It is very closely related to Dermocybe cinnabarina (Fr.) Wünsche, differing primarily in its preference for coniferous forests. D. cinnabarina occurs in Europe in deciduous forests with Fagus, Quercus or Carpinus.

Dermocybe phoenicea var. occidentalis (Smith) comb. nov.

BASIONYM: Cortinarius phoeniceus var. occidentalis Smith, Contr. Univ. Mich. Herb. 2:30-31. 1939.

PILEUS 30-80 mm broad, broadly convex, becoming expanded, more or less umbonate; margin usually decurved; surface moist to dry, innately silky becoming appressed fibrillose at maturity, often cracking radially in age, color evenly dark red to rich red (Ox-Blood Red to Garnet Brown) or dark mahogany red. Context rather thin, firm, color buff, with reddish tints near the cuticle and olive-brown coloration near the stipe; odor and taste none or not distinctive.

LAMELLAE adnate to adnexed, subdistant to distant or appearing close in small pilei, broad, equal, color deep purplish red (Bordeaux) to deep red, sometimes with brighter red (almost Carmine) edges, with a changeable or metallic sheen when viewed at different angles, becoming more or less rusty in age.

STIPE 40-110 mm long, 6-15(-30) mm thick, equal or sometimes clavate to ventricose, surface moist to dry, color evenly yellow (Mustard Yellow) to dull yellow (Chamois, Honey Yellow), or dull ochraceous, with a coating of yellowish fibrils, mycelium around base and in soil ochraceous to ocher-yellow (Yellow Ocher) or tinged reddish to vinaceous red. Context light yellowish olive (Old Gold), becoming sordid brownish in age.

CORTINA scanty, dull yellow (Chamois), light ochraceous or yellow-buff.

BASIDIOSPORES (6-)6.5-8(-9) x 4-5(-5.5) um, in profile view elliptical, in face view elliptical, verruculose, pale brownish with darker brown ornamentation. BASIDIA 4-spored, 24-31 x 6.5-7.5 um, clavate, thin-walled, hyaline or reddish to pinkish, some containing hyaline or reddish granules. PLEUROCYSTIDIA absent. CHEILOCYSTIDIA apparently absent. TRAMAL HYPHAE OF LAMELLAE subparallel to slightly interwoven, cylindrical to inflated, 5-18 (-23) um wide, hyaline to pinkish or light reddish vinaceous. CUTICULAR HYPHAE OF PILEUS interwoven, more or less radially arranged, cylindrical to inflated, 5-18 um wide, thin-walled, faintly colored or light brownish, light reddish to light vinaceous, or containing a concentrated reddish purple to bluish purple pigment and often purplish granules; pileocystidia absent (apex of end cells rounded to tapered). TRAMAL HYPHAE OF PILEUS interwoven, more or less radially arranged, cylindrical to inflated, 3-31 um wide, hyaline, yellowish, yellowish brown, or pale vinaceous. CLAMP CONNECTIONS of the normal type, present throughout the basidiomata. INTERHYPHAL PIGMENT DEPOSITS present in the pileus trama, the stipe cortex, and among the hyphae of the universal veil, in KOH yellowish, brownish orange, orange, or reddish orange.

Caespitose to gregarious or scattered in conifer or mixed woods (*Picea*, *Pinus*, *Pseudotsuga*, *Tsuga*). October to mid-December or sometimes as early as August in the higher mountains.

Collections examined. *California*. *Del Norte Co.*: A.H. Smith 8339, 8591, 8997, 55937 (all MICH). *Humboldt Co.*: J.F. Ammirati 8550 (WTU); H. Lamphere 34 (MICH); A.H. Smith 8679, 56057, 56228, 56282, 56517 (all MICH). *Mendocino Co.*: J.F. Ammirati 6213, 6215 (both MICH); H.D. Thiers 30399, 30429, 30862, 33278, 38386, 40483, 41649, 43935. *Monterey Co.*: H.D. Thiers 32169, 39598. *Yuba Co.*: H.D. Thiers 44130, 47142.

Dermocybe phoenicea var. *occidentalis* is the most frequently encountered member of section *Sanguineae* on the Pacific Coast, extending from California into Alaska. It also occurs in the mountains of the interior, where it can be found in some years as early as August. It prefers coniferous woods, but also occurs in mixed forests of conifers and deciduous trees.

As described by Smith (1989), *D. phoenicea* var. *occidentalis* has a dark red to rich red, silky to appressed fibrillose pileus, deep purplish red to deep red lamellae, and a yellowish to ochraceous stipe with a coating of yellowish fibrils. The stipe base being either ochraceous or tinted reddish. This is the most common form of this variety. On the Pacific Coast there is a less frequent form which has a dingy buff (Cinnamon-Buff) stipe coated with pale ferruginous red fibrils (for examples, A. H. Smith 56282 and 56517). This is not recognized here formally for two reasons. Firstly, these collections may simply represent one end of a color spectrum where the stipe ground color has lost the yellow coloration and the surface fibrils are more reddish. A similar pattern of variation can be seen in a close relative *D. semisanguinea* in both North America and Europe. Secondly, *D. phoenicea* var. *occidentalis* needs to be more carefully compared with European material of *D. phoenicea* var. *phoenicea* (Bull. ex Maire) Moser, to determine if they are really parts of the same species. Once this is accomplished variation in *D. phoenicea* var. *occidentalis* can be better evaluated and additional infraspecific taxa established it this is appropriate. *D. phoenicea* var. *phoenicea*, which has a more brownish to brownish red pileus, is not particularly common in North America and may occur only in eastern North America.

Dermocybe sanguinea (Wulf. : Fr.) Wünsche, Die Pilze. 125. 1877.

BASIONYM: *Agaricus sanguineus* Fr., Systema Mycologicum. I. 229.1821.

SYNONYMS: *Cortinarius sanguineus* (Fr.) S.F. Gray, *A Natural Arrangement of British Plants.* I. 629.1821.

Cortinarius sanguineus (Fr.) Fr. *Epicrisis Systematis Mycologici.* 288.1838.

PILEUS 18-45 mm broad, somewhat obtuse to convex or plane, disc more or less depressed; margin incurved to decurved; surface appressed fibrillose to minutely squamulose, sometimes radially rimose on the margin, color on disc rich red (Garnet Brown) to deep red (Maroon to deep

Garnet Brown) or tinted with colors of the margin, on margin rich red (Garnet Brown to Ox-Blood Red) or duller red (Coral Red), sometimes streaked deep red to fuscous-red (Maroon to Victoria Lake). Context watery deep red (Maroon to Garnet Brown), where faded or beneath cuticle lighter red (near Coral Red); odor somewhat fragrant, mild or raphanoid; taste mild to raphanoid.

LAMELLAE sinuate to broadly depressed with a more or less decurrent tooth, close, more or less ventricose when mature, at first rich red (Ox-Blood Red, dull Carmine or Garnet Brown), becoming shaded rusty brown to dusky brown from the basidiospores; edges uneven.

STIPE 45-85 mm long, apex 3-9 mm thick, equal or the base slightly enlarged; surface fibrillose, shiny, rich red (Garnet Brown, Ox-Blood Red) or duller red (Coral Red), sometimes with watery deep red (Maroon) streaks, base or lower third dull ochraceous (Ochraceous-Buff) or the ochraceous coloration slightly tinted orange to reddish. Context stuffed to narrowly hollowed, rich red (Garnet Brown to Ox-Blood Red) throughout or deeper red (Maroon) in the lower portion, where faded paler red.

BASIDIOSPORES 6.5-9(-10) x (3.5-)4.5-5(-5.5) um, in profile view elliptical, in face view elliptical to ovate, verruculose, color brownish to fulvous. BASIDIA 4-spored, 15-25 x 6-7.5 um, broadly clavate, clavate, or more or less ventricose, hyaline to pinkish. PLEUROCYSTIDIA absent. CHEILOCYSTIDIA 12-23 x 7-10 um, clavate to broadly clavate, thin-walled, color similar to basidia. TRAMAL HYPHAE OF LAMELLAE subparallel to slightly interwoven, cylindrical to more or less inflated, 5-25 um wide, hyaline, pale pinkish or light vinaceous. CUTICULAR HYPHAE OF PILEUS interwoven, more or less radially arranged, cylindrical to inflated, 8-30 um wide, thin-walled, pale pinkish to pale vinaceous or containing a more or less concentrated reddish to reddish vinaceous pigment; pileocystidia absent (hyphal end-cells with rounded to tapered apices). TRAMAL HYPAHE OF PILEUS interwoven, more or less radially arranged, cylindrical to inflated, 7-30 um wide, color as for the tramal hyphae of the lamellae or containing vivid red pigment and granules. CLAMP CONNECTIONS of the normal type, present throughout the basidiomata. INTERHYPHAL PIGMENT DEPOSITS present as small yellow to orange particles in H_2O, in KOH none observed.

Gregarious in mixed woods, mixed conifers, and Douglas fir stands. Mainly November through mid-January.

COLLECTIONS EXAMINED. *California*, Humboldt Co.: J.F. Ammirati 6187 (MICH); H. *Lamphere 56* (MICH); A.H. Smith 3747, 9156 (both MICH); H.D. Thiers 14358, 14427. Mendocino Co.: H.D. Thiers 9944, 14684.

Dermocybe sanguinea is widely distributed in North America and almost always occurs in coniferous woods. It is characterized by rich to deep red basidiomata that have ochraceous to orange-ochraceous mycelium over the stipe base. The pileus surface is typically appressed fibrillose with minute squamules or scales, especially on the margin. Along the Pacific Coast a more vivid red (Rose Red) to purplish red (Bordeaux) variant occasionally has been collected, for example, A.H. Smith 79922 (MICH), Tillamook Co., Oregon. Since its coloration integrades with that of typical *D. sanguinea*, and it does not differ significantly from the latter in other features, it is not recognized here as a separate taxon. Species in section *Sanguineae*, which might be confused with *D. sanguinea*, are *D. sierraensis* and *D. californica*. Check descriptions of these taxa before making a final determination.

Dermocybe semisanguinea (Fr.) Moser, Schweiz. Z. Pilk. 52:129. 1974.

BASIONYM: *Agaricus cinnamomeus* L. : Fr. var. *semisanguineus* Fr.

Cortinarius semisanguineus (Fr.) Gillet, Les Hymenomycetes. 486. 1874.

PILEUS 15-50(-70) mm broad, conic-campanulate to rounded-conic becoming convex to plane, umbonate to subumbonate; margin slightly inrolled at first becoming incurved to decurved; surface appressed fibrillose to fibrillose-scaly, sometimes more or less rimose on the disc, moist to dry, not hygrophanous, color on disc yellow-brown (Ochraceous-Tawny) or orange-brown (Amber Brown) or dark yellow-brown (Sudan Brown), on margin typically yellow-cinnamon to ochraceous brown or ochraceous-buff, sometimes when young tinted orange-buff (Apricot Buff), in age tinted or streaked with colors of disc, occasionally the overall coloration tinted with light olive-brown (Old Gold, Tawny Olive). Context solid, firm, dull whitish to light dull yellowish or slightly brownish, often becoming more or less sordid; odor and taste raphanoid or indistinctive.

LAMELLAE adnate to adnexed or emarginate, seceding in age, close to subcrowded, up to 9 mm broad, more or less ventricose mature, dull red (Dragon's-Blood Red to Brick Red) to deep red (near Morocco Red) or purple red (Bordeaux) becoming brownish to brownish orange in age; edges even to wavy.

STIPE 25-80 mm long, 4.5-15 mm thick, equal to more or less clavate or ventricose; surface appressed fibrillose, sometimes with a slight fibrillose annular zone near the apex, color pale yellow (pale Empire Yellow) to dull yellow, more or less concolorous with the pileus margin, or sometimes rusty-brown from the basidiospores in age, the base colored as above or with light reddish (Peach Red) to dull pinkish tones, becoming olivaceous in age in some specimens, some surface fibrils may be tinted brownish to reddish or pinkish. Context stuffed becoming hollowed, yellowish white to dull yellow or more or less concolorous with the surface, developing a watery olivaceous cast in age, in some the cortex of the stipe base has a reddish to reddish orange cast. CORTINA yellowish, evanescent.

BASIDIOSPORES in deposit moderate yellow-brown (near Snuff Brown), (5.5-)6-8.4(-11.7) x 3.8-4.8(-5.8) um, in profile view elliptical, in face view elliptical to broadly elliptical, verruculose, light brownish with darker brown ornamentation. BASIDIA 4-spored, 20-31 x 5.5-7 um, clavate to more or less ventricose, hyaline or reddish purple to purple. PLEUROCYSTIDIA absent. CHEILOCYSTIDIA apparently absent. TRAMAL HYPHAE OF LAMELLAE subparallel to more or less interwoven, cylindrical to inflated, 5-15(-20) um wide, hyaline or more commonly light purple, vinaceous purple, or reddish purple, some containing purplish granules. CUTICULAR HYPHAE OF PILEUS interwoven, more or less radially arranged, cylindrical to more or less inflated, 5-16 um wide, thin-walled, some encrusted, brownish to faintly colored or frequently containing more or less concentrated purple, bluish purple, or light vinaceous purple to bluish pigment and granules; pileocystidia absent (apex of end-cells rounded to tapered). TRAMAL

HYPHAE OF PILEUS interwoven, more or less radially arranged, cylindrical to inflated, 6-25 um wide, some encrusted, hyaline to pale yellowish or dingy yellow or in upper portion some similar to cuticular hyphae. CLAMP CONNECTIONS of the normal type, present throughout the basidiomata. INTERHYPHAL PIGMENT DEPOSITS present as small deposits or particles in the pileus, lamellae, and stipe, and among the cortinal hyphae, yellowish to orange or reddish.

Solitary, scattered, gregarious or caespitose in conifer and mixed woods, occasionally on rotten conifer wood. Rarely found in California, look for it in the autumn season, October thru December.

Collections examined. *California. Humboldt Co.*: H. Lamphere 33 (MICH).

Dermocybe semisanguinea appears to be a rare species in California; only one collection seen by the author to date. It is found across North America, typically in coniferous forests, but also in mixed forests. The distributions of *D. semisanguinea* and *D. phoenicea sensu lato* overlap in North America. However, the frequency with which one encounters the two species in western and eastern North America is striking different. *D. seminanguinea* is much more common in eastern North America than *D. phoenicea*. The latter rarely occurs there. *D. semisanguinea* is much less frequently found in the west, particularly along the Pacific Coast. Instead one finds *D. phoenicea* var. *occidentalis* as the common representative of this group. As one goes down the Pacific Coast into southern Oregon and Northern California *D. semisanguinea* is so infrequent that it is truely a rare find!

Dermocybe semisanguinea is a highly variable species in North America and is still under investigation. The description here represents a fairly broad concept of the species based on a number of collections. The closest relative of *D. semisanguinea*, *D. phoenicea* var. *occidentalis*, differs from the former primarily in its pileus color. In the former the pileus is usually some shade of yellow-brown while in the latter it is dark to rich red.

Dermocybe sierraensis sp. nov.

SYNONYMS: *Cortinarius sanguineus* (Wulf. : Fr.) S.F. Gray var. *sierraensis* G. Keller & J.F. Ammirati nom. prov., *Mycotaxon* 18(2):364. 1983.

Cortinarius sanguineus (Wulf. : Fr.) S.F. Gray var. *sierraensis* J.F. Ammirati & A.H. Smith nom. prov., *McIlvainea* 6(2):62. 1984.

PILEUS 20-40 mm latus, novus convexus, maturior plano-convexus, denique planus; margo incurvus, demum decurvatus vel planus; superficies sicca, glabra vel adpresse sericeo-fibrillosa, serius nitida, brunneo-aurantiaca. Contextus roseolus, 1-2 mm crassus, sapor odorque haud proprii.

LAMELLAE adnatae vel adnexae, angustae, atrorubrae, margines integri, concolores.

STIPES 20-40 mm longus, 2-4 mm crassus, aequalis, siccus; superficies pannis veli exceptis glabra, obscure vinacea in pili superficie colorem abeuns, mycelio basim versus vinaceo; panni veli cum superficie concolores; contextus solidus, cum superficie concolor.

BASIDIOSPORAE 7.7-9.1 (-9.5) x 4.8-5.5 (-5.8) um, facie obliqua elliptica, nonnumquam plus minusve reniformi vel enormi, verruculosae. BASIDIA quadrispora, 24.1-35.6 x 6.6-8.8 um, clavata vel aliquantum enormiter clavata, succum diffusum pallide purpureo-carneum continentia vel paulum carnescentia vel hyalina. CHEILOCYSTIDIA specie nulla. PILEI HYPHAE CUTICULARES plus minusve intertextae, aliquid per radios ordinatae, stratum distinctum efformantes, plerumque 2.9-13.1 um latae, cylindricae vel aliquatenus inflatae, succum diffusum pallide vel dilute purpureo-carneum vel carneo-rubrum continentes, denique in hyalinum pallescentes, tenuiter tunicatae, partim subtiliter incrustatae; pileocystidia nulla. PIGMENTUM INTER HYPHAS nullum in dilute KOH observatum.

In solo sub Pino contorta gregarii, altitudine 6500 pedum s. m., mense Augusto.

HOLOTYPUS: H. D. Thiers 32671, comitatu Alpine, respublicae Californiae, in herb. SFSU conservatus.

PILEUS 20-40 mm broad when fully expanded, convex when young becoming plano-convex to more commonly plane when fully mature; margin incurved becoming decurved to plane, entire, no veil fragments attached to edge and no apparent veil fragments on surface; surface dry, glabrous to appressed silky-fibrillose, usually shiny with age, color brownish orange to brownish red-orange (Cinnamon Rufous to Tawny) during all stages of development. Context pink, unchanging when exposed or bruised, 1-2 mm thick; taste and odor not distinctive.

LAMELLAE adnate to adnexed, narrow, somewhat wavy when mature, close (based on dried specimens), thin, several tiers of lamellulae, color dark red (Hays Russet to Grenadine Red) during all stages of development; edges entire, concolorous with faces.

STIPE 20-40 mm long, 2-4 mm thick, equal, dry; surface glabrous except for patches of veil tissue, color deep vinaceous to almost concolorous with the surface of the pileus, vinaceous mycelium at base; veil fragments concolorous with the surface. Context solid and concolorous with the surface.

BASIDIOSPORES 7.7-9.1(-9.5) x 4.8-5.5(-5.8) um, in profile view elliptical, some more or less reinform or somewhat irregularly shaped, in face view elliptical to broadly elliptical, verruculose with coarser ornamentation towards distal end, light Ochraceous Tawny to light yellow-brown with darker brown ornamentation. BASIDIA 4-spored, 24.1-36.5 x 6.6-8.8 um, clavate to somewhat irregularly clavate, containing a light purplish pink diffuse pigment or slightly pinkish to hyaline. PLEUROCRYSTIDIA absent. CHEILOCYSTIDIA apparently absent. SUBHYMENIAL HYPAHE compactly interwoven, cylindrical, mostly 2.9-6 um wide, color similar to tramal hyphae of lamellae. TRAMAL HYPHAE OF LAMELLAE subparallel, more or less interwoven, cylindrical to inflated, mostly 3.3-25.6 um wide, at first pale to light pinkish purple or pinkish red, often fading to paler or hyaline, some with purplish red granules. CUTICULAR HYPHAE OF PILEUS more or less interwoven, somewhat radially arranged, forming a distinct layer, mostly 2.9-13.1 um wide, cylindrical to somewhat inflated; containing diffuse pale to light dull purplish pink to pinkish red pigment, eventually fading to hyaline, thin-walled, some finely encrusted; scattered hyphal end cells present but no true pileocystidia seen. TRAMAL HYPHAE OF

PILEUS interwoven, more or less radially arranged, 2.9-29.9 um wide, cylindrical to inflated, reddish pink to purplish red-pink or pale pinkish purple at first, fading to hyaline or nearly so, scattered hyphae with light yellow-brown pigment. CORTICAL HYPHAE OF STIPE longitudinally arranged, subparallel to somewhat interwoven, 2.9-18.3 um wide, cylindrical to inflated, purplish red to purplish pink fading to hyaline; hymenial elements decurrent on stipe apex, some more or less differentiated as caulocystidia, 16.1-42.3 x 10.2-13.1 um (some additional hyphal end-cells scattered over surface), clavate to broadly clavate more or less cylindrical, or more spherical, occasionally catenulate, pale pinkish purple to hyaline. CORTINAL HYPHAE cylindrical, mostly 3-5 um wide, color similar to cortical hyphae of stipe (few observed). CLAMP CONNECTIONS of the normal type, present throughout the basidiomata. INTERHYPHAL PIGMENT DEPOSITS not observed in KOH.

Gregarious in soil under lodgepole pine, 6,500', August.

Collections examined. *California*. Alpine Co.: H.D. Thiers 32671 (holotype, SFSU). Mariposa Co.: H.D. Thiers 21106.

Dermocybe sierraensis appears to be a rare species of the western mountains. So far it is only known from the higher elevations of the Sierra Nevada Mountains. Studies of its pigmentation (Keller and Ammirati, 1983) show a close relationship to *D. sanguinea*, except that the former contains much less emodin and dermocybin in the material studied to date. *D. sierraensis* is distinguished from *D. sanguinea* by its silky fibrillose, brownish orange to brownish red-orange pileus, the lack of ochraceous mycelium on the stipe base, and somewhat larger basidiospores. *Dermocybe sanguinea* var. *vitiosa* Moser has some characteristics (more red-brown color of the pileus, rose colored basal mycelium and absence of emodin) in common with *D. sierraensis*, but an overall comparison indicates that they are not the same taxon.

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LICHENS OF MOUNT DIABLO STATE PARK, CONTRA COSTA COUNTY, CALIFORNIA

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SUMMARY

A preliminary catalog of the lichens of Mount Diablo State Park is presented with updated nomenclature and comments. Fifty-five genera are reported, including 140 species (nine are new additions). Most abundant are Parmeliaceae, which include nine genera and 24 species.

INTRODUCTION

Mount Diablo rises to 3849 ft in Contra Costa County, California, about 40 mi ENE of San Francisco. Because of its height and location along the western edge of California's large inland valley, United States surveyors selected Mount Diablo as a base meridian (37°53'N) used today in legal descriptions and maps.

In 1965, when my study began, Mount Diablo State Park did not include North Peak or Eagle Peak, which were added during the acquisition of additional parcels of land (lichens from these areas are included in the list). The state park now covers 18,000 acres.

According to Pampeyan (1963), most of Mount Diablo is underlain by a plug of broken and jumbled Upper Jurassic sedimentary, igneous, and metamorphic rock of the Franciscan formation, which was thrust upward through surrounding rocks and lubricated by serpentine veins present on the north side. Exposures of greenstone, chert, graywacke, shale, limestone, schist, and conglomerate comprise most of the northern end of the mountain, including the summit. Three ridges on the northern side of the mountain are North Peak to the northeast (3563 ft), of greenstone, pillow basalt and fine-grained basalt; Eagle Peak to the northwest (2369 ft), of diabase; and Deer Ridge, just south of Eagle Peak, a grassy area supporting lichens on soil. The southwest side of the mountain consists mainly of fossiliferous clastic marine beds ranging from late Jurassic to late Miocene. Sandstone is abundant, consisting of 33-50% feldspar, of granitic origin.

On the north-facing slopes of the summit, *Quercus chrysolepis* Liebm. grows with occasional *Umbellularia californica* Nutt. On lower north-facing slopes on the southern side of the mountain, there is an association consisting of *Q. agrifolia* Nee and *Aesculus californica* (Spach) Nutt. with some *Arbutus menziesii* Pursh. *Umbellularia californica* and *Acer macrophyllum* Pursh are found in canyons. An association of *Q. douglasii* H. & A. and *Pinus sabiniana* Dougl. occurs on dry slopes. A chaparral cover on the south side of the mountain consists chiefly of *Adenostema fasciculatum* H. & A. and *Salvia mellifera* Greene, with *Arctostaphylos glauca* Lindl., *A. auriculata* Eastw., and *A. manzanita* Parry in areas more protected from the fires that occasionally sweep through the area. (An extensive fire occurred in 1968). A chaparral association of *Q. durata* Jeps. and *A. glauca* occurs mostly at low elevations along canyons (Bowerman, 1944). *Juniperus californica* Carr. is frequent on rock outcrops, especially at ca. 2990 ft, and along a series of chert outcrops from the summit to the margin of the chaparral

1000 ft lower (Bowerman, 1944). Other chaparral plants include *Q. wislizenii* A.DC. var. *frutescens* Engelm. and *Ceanothus cuneatus* (Hook.) Nutt. Lichens were also found on *Salix* sp., *Q. dumosa* Nutt., and *Pinus coulteri* D. Don.

Mount Diablo has a Mediterranean climate. Annual temperature averages 59.3°F, with average annual extremes between 26.1°F and 103°F, normally 43-46°F (rainy winter, with occasional snow) to 73-82°F (dry summer). Fog from the west, which may occur 0.2 of the year on the westerly slope, also encompasses a mixture of smog that may limit lichen growth. However, the influence of smog on Mount Diablo lichens has not been studied. Many *Usnea* thalli exhibit excessive formation of fibrils, an apparent indicator of unfavorable growth conditions, many of which probably involve environmental factors detrimental to growth (Tavares, pers. com.).

A comparison of the following list with Herre's (1910) enumeration of the lichens of the Santa Cruz peninsula reveals the absence of many coastal taxa as well as taxa characteristic of the North Coast Ranges [*e.g.*, *Nephroma laevigatum* Ach. and *Sphaerophorus globosus* (Huds.) Vainio]. A comparison with Hebert and Meyer's list (1984) of lichens of the San Joaquin Experimental Range reveals the presence of some taxa found on the eastern slopes bordering the Central Valley of California [*e.g.*, *Lecidea atrobrunnea* (Ramond *in* Lam. & DC.) Schaerer]. Other taxa from the Sierra Nevada foothills have not been found on Mount Diablo [*e.g.*, *Peltula zahlbruckneri* (Hasse) Wetm., *Rhizoplaca glaucophana* (Nyl. ex Hasse) W. Weber, and *R. marginalis* (Hasse) W. Weber. On the other hand, *Bryoria* and *Usnea* were not reported from the San Joaquin Experimental Range.

LIST OF LICHEN SPECIES ON MOUNT DIABLO

In the following list, an * indicates a new record not included in Baltzo (1970). All lichens on the list were found within the present park boundaries except *Lecidea fuscoatra* from Marsh Creek Springs. For nomenclature see Egan (1987) and Tucker and Jordan (1978). The name used by Baltzo (1970) or in a published record is indicated in parentheses when it differs from the lichen name currently used. Voucher specimens are in the author's herbarium.

Acarospora chlorophana (Wahlenb. ex Ach.) Massal. Literature report (as *Lecanora chlorophana*, Tuckerman (1882).

***A. fuscata* (Nyl.) Arnold. Medium to dark brown, shiny to dull, one to several apothecia in each areole-squamule. C^+ fleeting red (section, on bruised cells just under brown cortical cells). On rocks in sun. (*Baltzo 4992c-82FF*).

A. schleicheri (Ach.) Massal. Pale sulphur yellow (as contrasted to lemon yellow of *A. chlorophana*). Apothecia darker than thallus. On sunny rocks.

Actinogyra see *Umbilicaria.*

Alectoria see *Bryoria.*

**Aspicilia calcarea* (L.) Mudd. Flat to convex, medium gray areoles; dark fimbriate hypothallus, cortex K^-. On red Franciscan chert. (*Baltzo 4990-82FF*).

A. cinerea (L.) Koerber. On shale (as *Lecanora cinerea*). On rock (as *Lecidea tesselata*).

A. gibbosa (Ach.) Koerber (as *Lecanora gibbosula*). On sandstone, unspecified rock.

A. laevata (Ach.) Arnold (as *Lecanora laevata*). On jasper-like rock, sandstone.

Bryoria oregana (Tuck. *ex* Willey) Brodo & Hawksw. (as *Alectoria oregana*). Poor specimen, on *Adenostoma* (collected before 1968 burn), 2500 ft.

Buellia punctata (Hoffm.) Massal. On *Pinus sabiniana.*

Caloplaca bolacina (Tuck.) Herre. Thallus dark lemon yellow, apothecia orange, spores 12-16 × 6-8 μm. On sandstone. 1400 ft.

C. chrysophthalma Degel. On bark.

C. decipiens (Arnold) Blomb. & Forss. On sunny siliceous shale, serpentine, jasper; widespread.

C. ferruginea (Huds.) Th. Fr. On bark of deciduous *Quercus*, chaparral.

C. laeta Magnusson. On sandstone.

C. stanfordensis Magnusson. On old *Salix.*

C. sp. (as *C. elegans*), sect. *Gasparrinia*. Dark red-orange, long narrow lobes to 6 mm long and 0.3 mm wide, not spreading at tips; spores ellipsoid to almost lemon shaped, 4.8-6.4 × 10-12.8 µm. On jasper-like rock in sun, serpentine.

C. spp. (as *C. murorum*). Thalli vary from orange with orange pruina to dark orange or two-toned red to orange, the lobes 0.5-1 mm wide, 2-3 mm long. On serpentine, non-calcareous rock.

Candelaria concolor (Dickson) B. Stein. On bark of most trees, dead and down wood, sandstone, widespread.

Candelariella vitellina (Hoffm.) Müll. Arg. On soil, moss, rock, sandstone.

Catapyrenium lachneum (Ach.) R. Sant. (as *Lecidea lurida*). In noncalcareous soil crevice of North Peak saddle.

Cetraria see *Tuckermannopsis*.

Cladonia cervicornis (Ach.) Flowtow. ssp. *verticillata* (Hoffm.) Ahti (as *C. sub cervicornis*). syn. *C. verticillata* (Hoffm.) Schaerer. P^+ yellow to red, K^-. On sandy soil. ±1500 ft.

C. chlorophaea (Floerke ex Sommerf.) Sprengel. Variously P^+ dark red, orange; K^-; KC^-; C^-. (chemical species not separated). On sandy soil, sandstone, soil and moss, 1400-1600 (-3000) ft, North Peak area.

C. fimbriata (L.) Fr. On soil, 1500 ft.

C. macilenta Hoffm. On *Pinus*, ±2100 ft.

C. ramulosa (With.) Laundon (as *C. pityrea*). On shaded sandstone, 1500 ft.

Collema furfuraceum (Arnold) Du Rietz. Pointed isidia. On bark, base of *Quercus agrifolia*, on *Juniperus californica*, on *Sambucus*, ±1500-2900 ft.

C. nigrescens (Huds.) DC. Isidia granular to globular when present; many apothecia. On *Quercus* bark, ±1500-2100 ft.

Dermatocarpon miniatum (L.) Mann. On rock, near waterfalls and moist vertical surfaces, ±2200 ft.

D. reticulatum Magnusson. On rock near summit, ±3849 ft.

**Dimelaena oreina* (Ach.) Norman. On rock, between Muir Area and North Peak, 2970-3563 ft (*Baltzo 777-69R*).

Diploschistes muscorum (Scop.) R. Sant. (as *D. actinostomus*). On sandstone, *Cladonia*, and on moss.

**D. scruposus* (Schreber) Norman. On rock, Boundary Area (*Baltzo 1605-78CC*).

Evernia prunastri (L.) Ach. (as *E. prunastri* var. *servediifera*). Esorediate to sorediate or isidiate; juvenile with aspect of *Pseudevernia*, white below, lobes flat, expanded, curled when sorediate; widespread on dead wood; chaparral (*Quercus*, *Adenostoma*).

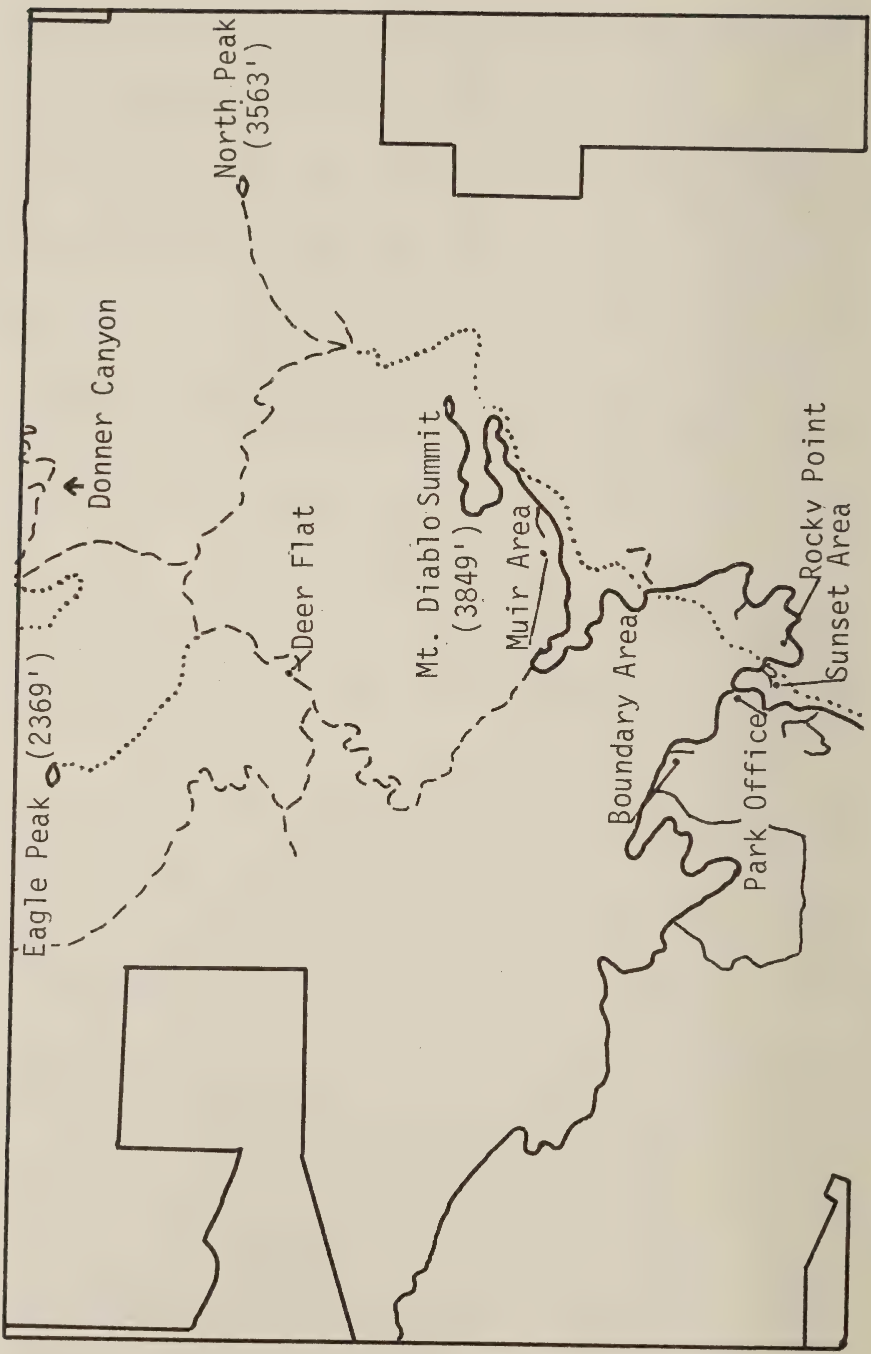
Flavoparmelia caperata (L.) Hale (as *Parmelia caperata*). With pustulate or powdery laminal soralia, no pseudocyphellae, rare apothecia with sorediate margin. On *Quercus* bark, sandstone, ±1500-1600 ft, widespread.

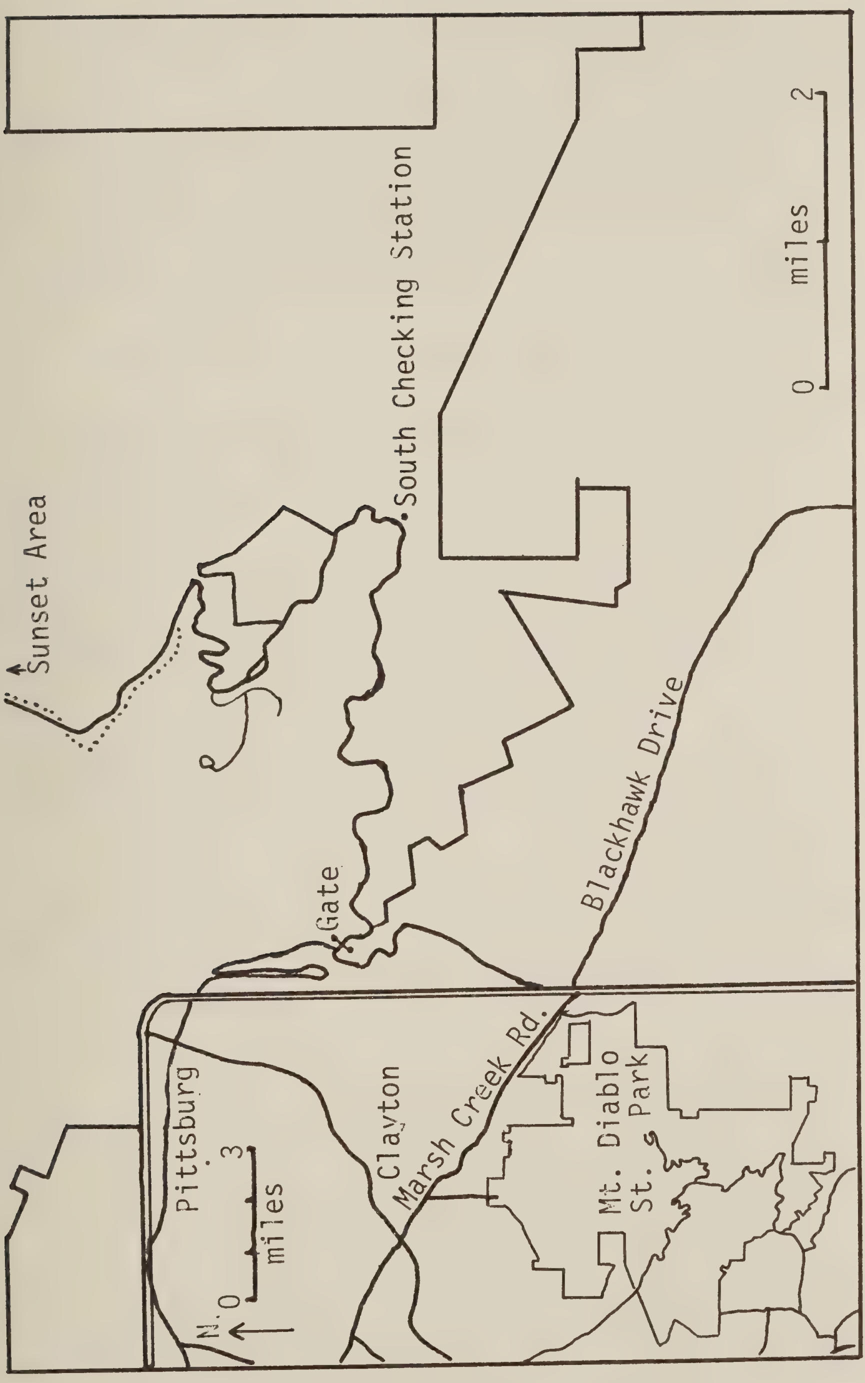
Flavopunctelia flaventior (Stirton) Hale (as *Parmelia flaventior*). Pseudocyphellate, differing from *Punctelia subrudecta* by more yellow-green color and dark brown underside. On bark, dead wood, sandstone, *Acer*, chaparral (*Arctostaphylos*, *Quercus*), widespread.

Hypocenomyce scalaris (Ach.) *ex* Liljeblad) M. Choisy (as *Lecidea scalaris*). On burnt wood of *Pinus coulteri*, ±1500 ft.

Hypogymnia imshaugii Krog (as *H. enteromorpha*). Variable in form: small thalli with lobes 1-2 mm wide, slightly flattened, regularly dichotomous with pointed tips, internodes 1-2 mm long, cortex P^+ yellow to orange, K^+ yellow, on twigs of *Adenostoma*; more typical elongate form, gray, lobes 1-3 mm wide, well developed, black to dark brown below, almost channeled but hollow, elongating tips pointed but not flattened, internodes 4-6 mm long, apothecia large, on *Quercus wislizenii* var. *frutescens*, *Umbellularia californica*; narrow, dark gray or brown, lobes 1-1.5 mm wide, regular, not flattened, with perforations below near tips, internodes to 5 mm long; or compact, light gray-brown, lobes to 2 mm wide, becoming wrinkled-inflated or pustulate centrally, internodes to 2 mm long, on *Quercus*, *Pinus* bark.

H. tubulosa (Schaerer) Havaas. Tubes with tips of soredia around edge. On bark, *Quercus*.


North Peak
(3563')
Donner Canyon
Eagle Peak (2369')
Deer Flat
Mt. Diablo Summit
(3849')
Muir Area
Boundary Area
Park Office
Rocky Point
Sunset Area


Sunset Area
South Checking Station
Gate
Blackhawk Drive
Pittsburg
Clayton
Marsh Creek Rd.
Mt. Diablo St. Park
N.
0
3
miles
0
miles
2

Koerberia biformis Massal. On *Aesculus*, 2150 ft.

Lecanora see also *Aspicilia.*

L. caesiorubella Ach. ssp. *merrillii* Imsh. & Brodo (as *L. pallida* group). On bark, twigs. Also literature report (Imshaug & Brodo, 1966).

L. hagenii (Ach.) Ach. On sandstone, ±1500 ft.

L. mellea W. Weber (as *L. bolcana*, *L. muralis* var. *diffracta*, *L. garovaglii*). Rich, dark honey color, the lobate margins with thin black edge, the lobes breaking up into several thinner lobe tips, thallus very variable, apothecial disc and margin same color as thallus, inconspicuous. In sun on jasper-like rock, quartz, igneous rock, shale, often in association with *Aspicilia* sp. Also literature report (Weber, 1975).

L. muralis (Schreber) Rabenh. (in part as *L. muralis* var. *versicolor*). On sandstone, jasper and other rock.

L. pacifica Tuck. or similar to it in appearance. No crystals in the apothecia. Thallus K$^+$ yellow. On twigs, 2500 ft.

L. rupicola (L.) Zahlbr. Pruinose, pale. On rock, 2380 ft.

Lecidea see also *Aspicilia*, *Hypocenomyce*, *Lecidella*, *Pannaria*, *Psora.*

L. atrobrunnea (Raymond in Lam. & DC.) Schaerer. Shiny red brown thallus, areole-squamules thin to thick and convex; waxy epicortex is thin; cortex UV$^+$ yellow-cream; medulla I$^+$. Apothecial discs smooth in appearance. Similar to *Rhizocarpon bolanderi*, which is UV$^-$ and has much smaller areoles and rough apothecial discs. On shale.

**L. fuscoatra* (L.) Ach. Semi-shiny to dull dark brown thallus, areole-squamules thinner than in *L. atrobrunnea*, with more intervening space showing black hypothallus; squamules becoming irregularly crenulate and turned up marginally, UV$^-$; apothecia may be pruinose. Between Sunset Area and Rocky Point, 2200 ft (*Baltzo 90-65C*); collected outside the State Park, on volcanic plug at Marsh Creek Springs (*Baltzo 9048-87JJ*) (several volcanic plugs were mentioned by Pampeyan, 1963, northeast of the base of Mount Diablo along Marsh Creek Rd.).

L. mannii Tuck. Literature reports (Tuckerman, 1888; Herre, 1910). Thalli on "volcanic rock," "Diablo" (Bolander 208a,b: see Tuckerman, 1888) (FH) are dull medium brown to pale brownish cream color, the areoles crowded, their edges turning downward; hypothallus not clearly visible between areoles. Cortex UV$^-$; medulla thick, white, UV pale greenish, I$^-$. Precise collection locality not known and rocks vary.

Lecidea sp. (as *L. mannii*). Much darker brown than *L. mannii* of Bolander; shinier, UV$^-$, medulla I$^-$ (*Baltzo 110-65C*).

**Lecidea* sp. Pale cream, dull; large slightly convex, crowded areoles, paler than Bolander specimens of *L. mannii* and having larger areoles. With *Rhizocarpon bolanderi*, near summit. Dull rusty orange under UV, perhaps because of lack of a dark brown pigment. On rock.

**Lecidea* sp. Medium gray brown granular surface broken into areolate segments; apothecia black. On sandstone.

Lecidella euphora (Floerke) Hertel (as *Lecidea glomerulosa*). C$^-$, K$^-$. On *Juniperus* twigs, *Pinus*, dead or down wood.

Lepraria neglecta (Nyl.) Lettau. On sandstone, 1500 ft.

Leptochidium albociliatum (Desmaz.) M. Choisy (as *Polychidium albociliatum*). On moss and soil, among grasses, mossy rock.

Leptogium californicum Tuck. On shaded sandstone.

L. corniculatum (Hoffm.) Minks (as *L. palmatum*). On moss, soil, rock.

L. furfuraceum (Harm.) Sierk. On *Acer*, *Aesculus*.

L. lichenoides (L.) Zahlbr. On moss, soil.

L. minutissimum (Floerke) Fr. On soil.

Letharia columbiana (Nutt.) Thomson. On burnt bark, *Pinus sabiniana*; immature, isidiate, nonsorediate.

Lichinella stipatula Nyl. Literature report (Henssen, 1963; W. A. Weber collection).

Melanelia fuliginosa (Fr. ex Duby) Essl. (as *Parmelia glabratula*). Medulla C$^+$ red, shiny cylindrical isidia. On bark of *Quercus*, *Pinus*.

M. glabra (Schaerer) Essl. (as *Parmelia glabra*). Medulla C^+ red, thallus minutely pubescent, lowerside dark brown to black. On bark of *Quercus*, *Pinus*, *Sambucus*, *Adenostoma*, *Juniperus*, chaparral, widespread. A form referred to as "*subglabra*" differed by its paler olive-green color perhaps due to shady conditions, its lower side pale in a broad band on the margins and medium brown centrally. Loosely adnate on mosses on bark.

M. glabroides (Essl.) Essl. (as *Parmelia* "*pseudoglabra*"). Medulla C^+ red, KC^+ red; lobes shiny scalloped-crenulate, reticulate-ridged, lacunose, in cushions. On sandstone, soft shale, moss, easily removed from substrate.

M. incolorata (Parr.) Essl. (as *Parmelia elegantula*). Medulla C^-, warts not prominent; isidia ±round at first, not pinched at base, becoming cylindrical, sometimes in clusters, infrequently branched. Thallus sometimes pruinose. On bark, twigs, sandstone.

M. multispora (A. Schneider) Essl. (as *Parmelia multispora*). Medulla C^-, thallus like *M. subolivacea* but thinner, asci with more than 8 globose to subglobose spores. On bark, *Quercus*.

M. subargentifera (Nyl.) Essl. (as *Parmelia subargentifera*). Medulla C^+ red; marginal labriform soralia, minutely pubescent upper side. On sandstone, moss.

M. subaurifera (Nyl.) Essl. (as *Parmelia subaurifera*). Medulla C^+ red; soralia laminal, punctiform, tending to yellowish to greenish; isidia cylindrical, short. On bark, *Quercus*; frequent.

M. subelegantula (Essl.) Essl. (as *Parmelia* "*pseudoaspera*"). Medulla C^-; warts with white area a top that is sometimes depressed; starting at thallus margins, warts be come transformed into dull cylindrical isidia in center; isidia may becom coralloid or lobulate and drooping. On bark, *Quercus* sp., *Q. wislizenii*, *Pinus*, *Ceanothus cuneatus*, *Umbellularia*, to 3849 ft.

M. subolivacea (Nyl. *in* Hasse) Essl. (as *Parmelia subolivacea*). Medulla C^-; warts on mature thalli irregular in shape, never isidiate-coralloid or lobulate. On bark, *Quercus*.

Neofuscelia loxodes (Nyl) Essl. (as *Parmelia isidiotyla*). Medulla C^-; cortex C^+ dark blue gray; isidia coarse, dull, globular clusters that may break to show white medulla or resemble soredia. On rock, shale, sandstone.

Normandina pulchella (Borrer) Nyl. Minute pale green ear-like squamules that become sorediate on the edges. On bark of *Acer* and sandstone.

Ochrolechia subpallescens Vers. Thallus and thick apothecial margin C^+ red. On bark, *Acer* and *Quercus*.

O. upsaliensis (L.) Massal. Literature report (Herre, 1910). Thallus C^-. On sandstone and over mosses.

Pannaria leucophaea (Vahl.) P. Jørg. (as *Lecidea demissa*). Minute, dull, medium brown. On sandstone.

**P. leucostictoides* Ohllson. Pale tan, becoming bluish pruinose; isidia blue-gray. On *Quercus* (*Baltzo 47b-65A*).

P. praetermissa Nyl. *in* Chyd. & Furuhj. (as *Parmeliella praetermissa*). Dark brown; isidia dark gray. On moss on rock.

Parmelia see also *Flavoparmelia*, *Flavopunctelia*, *Melanelia*, *Neofuscelia*, *Parmelina*, *Parmotrema*, *Punctelia*, and *Xanthoparmelia*.

P. saxatilis (L.) Ach. Isidiate. On bark of *Quercus*, moss, sandstone.

P. sulcata Taylor. Sorediate on ridges. On bark, *Quercus*, *Pinus*, *Juniperus*, on shaded sandstone, widespread.

Parmeliella see *Pannaria*.

Parmelina quercina (Willd.) Hale (as *Parmelia quercina*). On bark, *Quercus* sp., *Q. wislizenii*, *Pinus*, *Juniperus*, *Umbellularia*, widespread.

Parmotrema arnoldii (Du Rietz) Hale (as *Parmelia arnoldii*). Medulla K^-; soralia on small lobes, submarginal. On bark of *Quercus agrifolia*.

P. chinense (Osbeck) Hale & Ahti (as *Parmelia perlata*). Medulla K^+ yellow; soralia on revolute lobe tips. On *Quercus*.

P. stuppeum (Taylor) Hale (as *Parmelia stuppea*). Medulla K^-; soralia linear on raised margins; cilia long; lobes wide. On sandstone.

Peltigera collina (Ach.) Schrader. On moss on sandstone in shade.
Peltula euploca (Ach.) Ozenda & Clauz. On rock, 3700 ft.
Pertusaria albescens (Huds.) M. Coisy & Werner. On *Quercus.*
P. amara (Ach.) Nyl. Bitter taste. On bark, *Quercus.*
P. chiodectonoides Bagl. ex Massal. On rock.
P. lecanina Tuck. On *Quercus*, bark.
Phaeophyscia orbicularis (Necker) Moberg (as *Physcia orbicularis*). On bark, *Quercus, Juniperus, Aesculus.*
Phlyctis argena (Sprengel) Flotow. On bark.
Physcia adscendens (Fr.) H. Olivier. Hooded soralia. On *Quercus, Juniperus*, widespread.
P. aipolia (Ehrh. ex Humb.) Fuernr. White-spotted, cortex K^+ yellow. On *Acer, Aesculus, Juniperus.*
P. alba (Fee) Müll. Arg. var. *obsessa* (Mont.) Lynge (as *Physcia alba*). On dead wood (*Juniperus*?).
P. albinea (Ach.) Nyl. On red jasper-like rock.
P. callosa Nyl. On shale, shaded sandstone, moss on rock.
P. cascadensis Magnusson. On *Quercus.*
P. mexicana B. de Lesd. On *Quercus agrifolia.*
P. millegrana Degel. On heavy rock with quartz.
P. phaea (Tuck.) Thomson. On *Quercus agrifolia.* Also literature report (Thomson, 1963).
P. semipinnata (J.F. Gmelin) Moberg (as *P. leptalea*). On *Adenostoma.*
P. stellaris (L.) Nyl. On *Adenostoma, Quercus, Juniperus*, chaparral. Four forms.
P. tenella (Scop.) DC. *in* Lam. & DC. On *Quercus, Juniperus*, over other lichens.
Physconia detersa (Nyl.) Poelt (as *Physcia grisea* f. *detersa*). On sandstone.
P. distorta (With.) Laundon (as *Physcia pulverulenta*). On bark of *Quercus, Acer, Juniperus, Umbellularia*, chaparral. Three forms.
P. enteroxantha (Nyl.) Poelt (as *Physcia grisea* f. *enteroxanthella*). On *Quercus, Sambucus*, shaded sandstone.
P. grisea (Lam.) Poelt. On *Juniperus, Quercus, Umbellularia*, sandstone.
P. muscigena (Ach.) Poelt. On dead and down wood, soil, moss.
Polychidium see *Leptochidium.*
Pseudocyphellaria anomala Brodo & Ahti. On moss at base of *Quercus agrifolia.*
P. anthraspis (Ach.) Magnusson. On base of *Quercus agrifolia.*
Psora californica Timdal (as *Lecidea globifera*). On soil in rock crevice.
P. globifera (Ach.) Massal. Medulla K^-. See Schneider (1979), Timdal (1986). On soil, sandstone.
P. nipponica (Zahlbr.) Schneider (as *Lecidea novomexicana*). In rock crevice.
Punctelia subrudecta (Nyl.) Krog (as *Parmelia subrudecta*). Differs from *Flavopunctelia flaventior* by mineral blue-gray-green color and pale beige underside. On bark of *Quercus, Pinus, Adenostoma*, chaparral.
Ramalina farinacea (L.) Ach. Typical form with narrow laciniae 1-2 mm wide, branching at 4-5 mm intervals, marginal soralia P^+ rusty orange, medulla P^+ rusty orange, cortex with two layers, K^+ yellow, on bark of *Quercus agrifolia* and *Acer.* Shorter tufted form, branching at 3-4 mm intervals, soralia only P^+ rusty orange, cortex without inner layer, on bark. Short form to 4.5 cm long, non-fistulose, expanding finger-like soraliate apices with marginal isidioid outgrowths, no inner cortex, on *Quercus* sp., *Q. agrifolia.* Broad form, laciniae to 2 mm wide, soralia on laciniae and margins, medulla P^-, soralia P^+ pale orange, no inner cortex. On *Q. agrifolia.*
R. leptocarpha Tuck. On bark.
R. menziesii Tayl. Coarse, rigid nets. On bark or draped on branches, infrequent.
**Rhizocarpon bolanderi* (Tuck.) Herre. Thallus shiny, dark red-brown, similar to *Lecidea atrobrunnea.* Apothecial disc appears rough. On rock near summit, 3800 ft. (*Baltzo 892b-69T*).
R. ferax Magnusson. On rock, 2200-3849 ft.

Rinodina hallii Tuck. On bark.

Sticta fuliginosa (Hoffm.) Ach. On shaded sandstone, *Quercus*, *Pseudocyphellaria anomala*.

Thelomma mammosum (Hepp *in* Hartung) Tibell (as *Cypheliopsis bolanderi*). On sunny rocks.

Tuckermannopsis chlorophylla (Willd. *in* Humb.) Hale (as *Cetraria chlorophylla*). On *Adenostoma*, shaded sandstone.

T. merrillii (Du Rietz) Hale (as *Cetraria merrillii*). On *Adenostoma*, *Quercus* bark.

T. orbata (Nyl.) Lai (as *Cetraria orbata*). On bark, on *Quercus*.

Umbilicaria phaea Tuck. On sandstone, metamorphic rock, shale, widespread.

U. polyphylla (L.) Baumg. On rock.

U. polyrrhiza (L.) Fr. (as *Actinogyra polyrrhiza*). On shaded rocks, 3000 ft.

Usnea arizonica Mot. *s. lat.* Medulla K^+ red. On bark of *Acer*, *Quercus agrifolia*.

U. cavernosa Tuck. (as *U. trichodea*). On *Quercus*.

Usnea spp. (tufted and pendent taxa). On *Quercus*, chaparral, 1500-2500 ft.

Xanthoparmelia cumberlandia (Gyelnik) Hale (as *Parmelia cumberlandia*). On sandstone, shale, in sun, 2100 ft.

X. lineola (Berry) Hale (as *P. lineola*). On sandstone, quartz, jasper.

X. mexicana (Gyelnik) Hale (as *P. mexicana*). On sunny rock, sandstone, quartz, or jasper.

X. novomexicana (Gyelnik) Hale (as *P. novomexicana*). On shale.

X. taractica (Kremplh.) Hale (as *P. ioannis-simae*, *P. taractica*). Loosely attached to soil on rock, on crumbly shale, on quartz.

Xanthoria candelaria (L.) Th. Fr. On *Quercus*, *Umbellularia*.

X. fallax (Hepp *in* Arnold) Arnold. On moss and rock, sandstone.

X. lobulata (Floerke) B. de Lesd. On calcareous sandstone.

X. parietina (L.) Th. Fr. On bark (*Quercus*?), 2700 ft; on *Aesculus*, Donner Canyon.

X. polycarpa (Hoffm.) Rieber. On *Quercus agrifolia*, other *Quercus* spp, *Pinus sabiniana*.

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THE GENUS RHODOCYBE: NEW COMBINATIONS AND A REVISED KEY TO SECTION RHODOPHANA IN NORTH AMERICA

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ABSTRACT

Entoloma trachyosporum and its varieties are placed in *Rhodocybe*. *Rhodocybe carlottae* var. *carlottae* is considered a synonym of *R. trachyospora* var. *trachyospora*, while *R. carlottae* var. *vinacea* is placed in *R. trachyospora* as a new variety. A key to *Rhodocybe* section *Rhodophana* in North America is presented.

KEY WORDS: *Rhodocybe*, section *Rhodophana*, nomenclature, key to species for North America.

INTRODUCTION

It is appropriate that this report concerns a furthering of our knowledge of fungi of the Pacific Northwest, since the scientist honored by the collection of papers in this festschrift has spent most of his distinguished professional career working towards that end. We hope this latest addition to our knowledge of the California mycota will please him.

The genus *Rhodocybe* Maire has recently received careful attention in North and Central America (Lennox, 1979; Baroni, 1981; Halling & Baroni, 1985; Redhead & Baroni, 1986; Ovrebo & Baroni, 1988) because the species of *Rhodocybe* can occasionally be a distinctive, though usually not a prominent, part of the mycota of a given area. Although a revision of *Rhodocybe* (Baroni, 1981) has helped clarify the unique features that circumscribe this member of the Entolomataceae Kotlaba & Pouzar, there still remains much to be learned about the number, distribution and phylogeny of species in *Rhodocybe* for North America, and on a world wide scale.

In this past collecting season, during the months of November and December in Humboldt and Mendocino Counties of California, we had the opportunity to collect all of the varieties of *Entoloma trachyosporum* Largent, i.e. *E. trachyosporum* var. *trachyosporum*, *E. trachyosporum* var. *griseoviolaceum* Largent and *E. trachyosporum* var. *purpureoviolaceum* Largent. An examination of the unusual basidiospores of each of these collections revealed to the senior author that these taxa clearly belong in *Rhodocybe*.

TAXONOMY

In the sense of Singer (1986), *Rhodocybe* is one of three genera placed in the Entolomataceae (*Clitopilus* and *Entoloma sensu lato* are the other two, but see Largent & Benedict, 1971; Baroni, 1981; and Baroni & Petersen, 1987). All taxa placed in the Entolomataceae possess the following suite of characters: spore deposit pinkish, flesh, vinaceous or rarely grayish; spores always distinctly angular or rounded angular in polar view, or the spores are angular in all views; spore walls evenly cyanophilic. *Rhodocybe* can only be accurately identified and separated from *Clitopilus* and *Entoloma sensu lato* by the unique, mostly isolated pustulate or tuberculate-warty ornamentation of its basidiospores. The basidiospores of *Clitopilus* are never angular in profile view, but possess distinct to obscure longitudinal ridges running the length of the spores, while the basidiospores of *Entoloma sensu lato* are provided with short interconnected ridges, which make the basidiospores distinctly angular in all views. The basidiospores of *Entoloma sensu lato* never have isolated pustulate or tuberculate-warty ornamentation.

After a study of the macroscopic and microscopic characters of all the collections of *E. trachyosporum* available to us, it became apparent that the recently described *Rhodocybe carlottae* var. *carlottae* Redhead & Baroni (Redhead & Baroni, 1986) from the Queen Charlotte Islands of British Columbia is conspecific with *E. trachyosporum* var. *trachyosporum*. However, in the case of *R. carlottae* var. *vinacea* Redhead & Baroni, the colors of the stipe, the lamellae and the pileus context indicate that this taxon is yet another distinct color variant of *E. trachyosporum* from the Pacific Northwest of North America.

The following new combinations and synonymy are necessary:

Rhodocybe trachyospora (Largent) Baroni & Largent *comb. nov.*

≡ *Entoloma trachyosporum* Largent, Madroño 22: 369. 1974.
= *Rhodocybe carlottae* Redhead & Baroni, Canad. J. Bot. 64: 1451. 1986.

Rhodocybe trachyospora var. **griseoviolacea** (Largent) Baroni & Largent *comb. nov.*

≡ *Entoloma trachyosporum* var. *griseoviolaceum* Largent, Madroño 22: 370. 1974.

Rhodocybe trachyospora var. **purpureoviolacea** (Largent) Baroni & Largent *comb. nov.*

≡ *Entoloma trachyosporum* var. *purpureoviolaceum* Largent, Madroño 22: 371. 1974.

Rhodocybe trachyospora var. **vinacea** (Redhead & Baroni) Baroni & Largent *comb. nov.*

≡ *Rhodocybe carlottae* var. *vinacea* Redhead & Baroni, Canad. J. Bot. 64: 1451. 1986.

After referring to our field data, and after a reexamination of the microscopic characters of the type collections of *E. trachyosporum* and its varieties, the following information can be added to the original descriptions (Largent, 1974).

Rhodocybe trachyosporum var. *trachyosporum* Figs. 1 & 2

Basidiospores 6-8(-9) (without apiculus), 7-10 (including apiculus) × 6-7(-8) µm, subglobose to ovoid or short-broad-ellipsoid, often obscurely to distinctly angular in profile view, rounded angular (6-9 facets) in polar view, weakly to moderately undulate-pustulate in all views, walls evenly cyanophilic but weakly so on many older (larger) spores. *Caulocystidia* present in inconspicuous clusters or scattered at apex of stipe, 22-45 × 8-10 µm, often capitate or subcapitate and pedicillate, or clavate or broadly ventricose, thin-walled, hyaline, with clamp connections.

Rhodocybe trachyosporum vars. *griseoviolaceum* and *purpureoviolaceum*

The microscopic features for both of these varieties are indistinguishable from those of var. *trachyosporum.*

These taxa were originally reported from a number of different counties around the greater Seattle, Washington area (Largent, 1974) as occurring under various conifer species. For example, *R. trachyosporum* var. *trachyosporum* was collected from beneath *Pseudotsuga menziesii* (Mirb.) Franco, *R. trachyosporum* var. *griseoviolaceum* was found beneath *P. menziesii, Thuja plicata* D. Don. and *Tsuga heterophylla* (Raf.) Sarg., while *R. trachyosporum* var. *purpureoviolaceum* was collected beneath *T. plicata.* The collections of *R. trachyosporum* var. *trachyosporum* (Baroni 5794, 5801 and 5802) and var. *griseoviolaceum* (Baroni 5803) from California were typically found under *Picea sitchensis* (Bong.) Carr. or *P. sitchensis* mixed with *Sequoia sempervirens*

Endl., while *R. trachyosporum* var. *purpureoviolaceum* (Baroni 5856) was found under a mixture of *P. menziesii*, *T. heterophylla*, *S. sempervirens* and *Lithocarpus densiflora* (H. & A.) Rehd. It appears then that these Rhodocybes may be found under various kinds of conifers throughout the Northern Coastal Coniferous Forest and the Redwood Forest (Munz, 1970) of California and the Pacific Northwest.

Using the infrageneric classification scheme of Baroni (1981), this group of taxa would be placed in *Rhodocybe* section *Rhodophana* (Kühner) Singer based on the presence of clamp connections and the lack of hymenial pseudocystidia. *Rhodocybe trachyospora* and its varieties would be closely aligned with *R. mycenoides*, *R. speciosa* and *R. priscua* due to their subglobose basidiospores, which are often angular in profile view. *Rhodocybe mycenoides* is known only from South America, while these other taxa with subglobose basidiospores are found in North America.

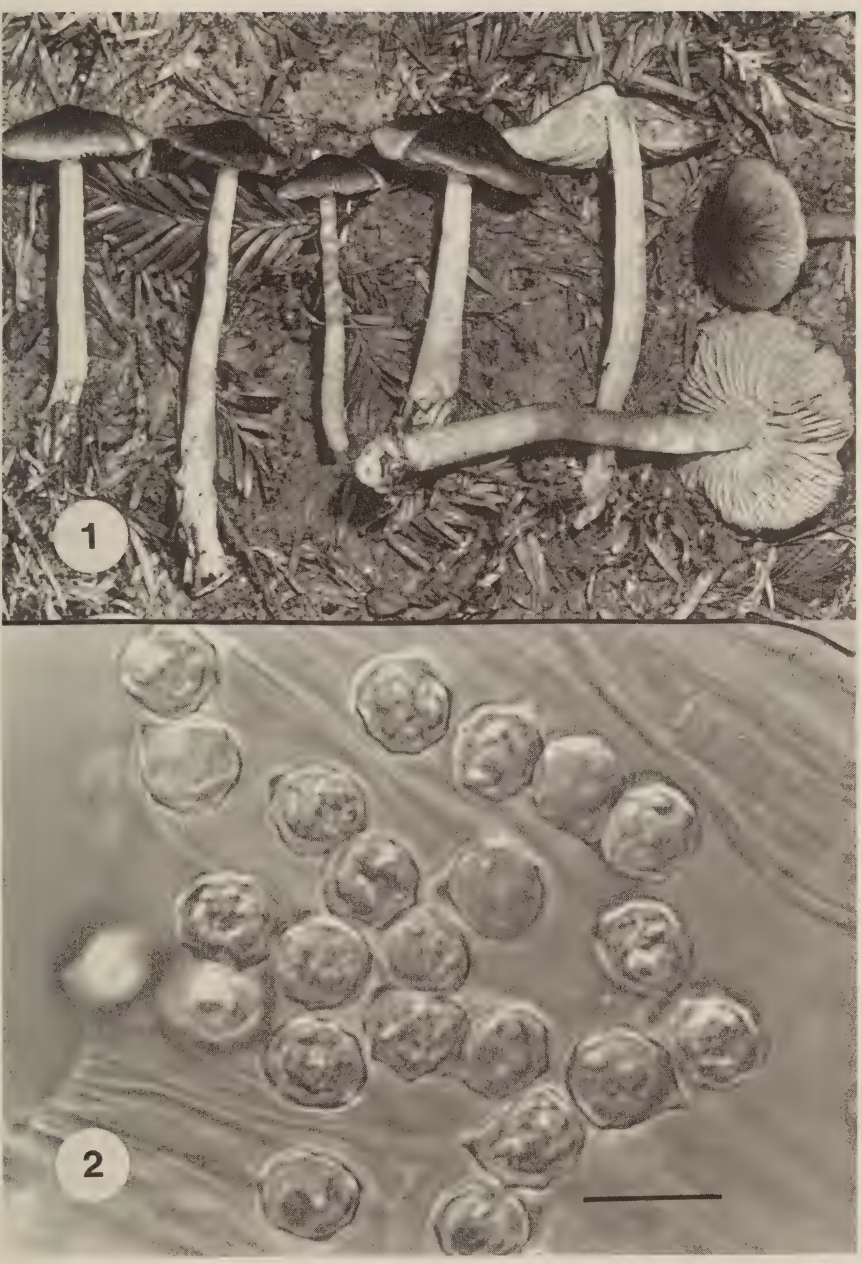
Key to North American taxa of *Rhodocybe* section *Rhodophana*

1. Basidiospores ellipsoid or amygdaliform and not angular in profile view..2
1. Basidiospores subglobose to short-broad-ellipsoid and often angular in profile view..3

2. Lignicolous; stipe eccentric; pileus light buff but soon developing pinkish hues; cheilocystidia thin-walled and clavate to sphaeropedunculate; laterostratum of lamellar trama gelatinized..*R. eccentrica* Baroni & Ovrebo
2. Terrestrial; stipe central; pileus ochraceous-tawny to orange cinnamon but fading to pinkish cinnamon to cinnamon buff; cheilocystidia not differentiated; lamellar trama not gelatinized..*R. nitellina* (Fr.) Singer

3. On decayed wood in coniferous forests; pileus tan or yellowish brown; stipe yellow or pale orange; end cells in pileipellis inflated as variously shaped pilocystidia; hyphae of lamellar trama and pileal context dextrinoid..*R. speciosa* Lennox ex Baroni
3. Terrestrial in coniferous forests; pileus differently colored; pilocystidia lacking; trama and context not dextrinoid..4

4. Under pines on needle beds; pileus and stipe umber or hazel, stipe eventually paler than pileus, becoming vinaceous buff or buff, stipe dry, finely striate and with a patchy hoary covering; odor of plastic; caulocystidia mostly clavate to cylindric..*R. priscua* Baroni
4. Under sitka spruce, western hemlock, Douglas fir, western red cedar, redwood, etc. (but not under pine) on needle beds or



Figs. 1-2: *Rhodocybe trachyospora* var. *trachyospora*. 1. Basidiomes, ×1 (*Baroni 5794*). 2. Basidiospores, scale bar = 10 μm (*Largent 2169*, HOLOTYPE).

bare soil; pileus mostly with grayish hues mixed in with browns, yellow-browns, vinaceous, purplish or fuscous colors, stipe differently colored than above, lubricous in wet or humid weather, glabrous or finely fibrillose-appressed striate or rimulose; odor not distinctive or somewhat fruity fragrant; caulocystidia variously shaped from cylindric to broadly ventricose, but most often sphaeropedunculate or pedicellate-capitate..5

5. Stipe off-white to pale grayish to pale grayish brown, context concolorous..*R. trachyospora*
5. Stipe dark blue to bluish gray, violaceous gray, or pale vinaceous gray, context concolorous or slightly paler.......................................6

6. Pileus dark grayish brown, becoming paler yellowish-brown over the margin with loss of moisture; lamellae pallid to grayish brown at first; pileus context sordid flesh buff...*R. trachyospora* var. *griseoviolacea*
6. Pileus dark purplish brown or reddish brown or fuscous purplish with vinaceous to reddish gray margin at first; lamellae bluish gray or livid to pale vinaceous at first; pileus context deep blue to grayish blue or pale vinaceous...7

7. Stipe dark blue to bluish gray; lamellae bluish gray at first; pileus context deep blue to bluish gray...*R. trachyospora* var. *purpureoviolacea*
7. Stipe pale vinaceous gray; lamellae livid to pale vinaceous at first; pileus context pale vinaceous..................*R. trachyospora* var. *vinacea*

For complete descriptions of these taxa refer to Baroni (1981), Ovrebo & Baroni (1988), Redhead & Baroni (1986) and Largent (1974). All color terms used in the keys are adapted from Kornerup and Wanscher (1978) and Rayner (1970).

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QUALITY CONTROL FACTORS FOR *ALTERNARIA* ALLERGENS

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Alternaria species are among the best known and most clinically important sources of fungal allergens (Lehrer, et al. 1983). To assess the role of environmental exposures to these allergens in human disease, fungus materials are grown in culture and extracted in aqueous media to produce reagents used for skin testing or in-vitro tests for the presence of allergen specific antibodies. The same materials are often used for desensitization therapy (immunotherapy). However, methods used in the production of *Alternaria* allergen materials for diagnosis and treatment as well as research utilize single isolates often without expert identification and improperly named (Vijay, et al. 1986) in spite of the fact that allergen content is known to vary with species and strain used.(Burge et al 19xx) Most methods are based on mycelial growth and metabolic products rather than spores (Solomon et al, 1980) and fail to take into account the inherent variability that is the bane of mycologists interested in *Alternaria* taxonomy (Norman, 1982).

We have studied spore-derived allergens from airborne strains of *Alternaria alternata* and morphologically similar taxa as well as a series of verified isolates of *A. alternata* known to be stable in culture.

METHODS

Four airborne isolates of *Alternaria* (entries 1-4 in Table I]: two *A. alternata*, and two unidentified species that were assumed to be *A. alternata* by mycologists not trained in *Alternaria* identification were maintained in culture on Sabouraud's broth (Hoffman, et al. 1981). On five occasions (12/84, 2/85, 5/85, 11/85, 5/86) spores and mycelium were harvested separately. Spore preparations, 90-95% pure by microscopic examination, were obtained by the method of Kozak and Gallup (U.S. patent #4,280,000). Briefly, a suspension of spores in distilled water was inoculated onto the surface of Sabouraud's Dextrose Agar (DIFCO, Detroit, MI) and spread evenly over the surface with a flame-sterilized bent glass rod. An overlay of Whatman filter paper #54 and a nondigestible material type TX 1040 (Pallflex Co.,Putnam, CN) were smoothed onto the inoculated agar surface. After incubation under room lights at room temperature for three weeks, the overlay growth mat was removed, culture medium discarded, and the overlay growth mat placed back in the petri dish and allowed to dry for 3-4 days. Spores were harvested by scraping the overlay surface with a dull knife. The resulting spore/mycelium mixture was separated in a 45 micron sieve (USA Standard Testing Sieve, Dual Manuf. Co., Chicago, ILL.) on a shaker at 2,000rpm. When the appearance of material in the sieve changed from the black dust of spores to the lighter color of broken mycelium, sieving was stopped.

Five *A. alternata* strains that had remained morphologically stable in culture for at least one year (Simmons 34-016, 34-039, 35-056, 35-193, 38-066) were maintained on 20% V-8 juice agar slants. On three occasions (9/29/86, 10/6/86, 10/28/86) spore material was harvested following the procedure of Kozak and Gallup, except that 20% V-8 juice agar was used instead of Sabouraud's medium, and growth time before harvesting spores was 5 days instead of three weeks. Material scraped from the overlay material was not separated by sieving, as microscopic examination revealed the presence of very few mycelial fragments.

Spores of the random air isolates (#1-4) were extracted at 1:10 w/v in 0.02% sodium azide in distilled water for 48 hours at 4°C, centrifuged at 10,800g, filtered through a 0.45um nitrocellulose filter, dialyzed for 48 hours against distilled water at 4°C, concentrated x10 and frozen.

Simmons' spore materials were extracted in the same manner, but each resulting spore extract was lyophilized. The possible differential effects of culture medium and lyophilizing vs concentrating and freezing on the allergen profile of extracts were assessed. *Alternaria* isolate A1005 was grown on 20 V-8 juice agar and spores were harvested and extracted on two separate occasions, both times dividing the extract into two portions; one concentrated and frozen, the other, lyophilized. Extracts were compared using the following isoelectric focusing (IEF) and Western blot techniques, and allergens detected as described.

For IEF, extracts of isolates 1-4 were thawed and used immediately, while lyophilized material was reconstituted to 10 mg/ml with distilled water. Each extract was focused twice on 0.5mm polyacrylamide gels, pH 3-10, using Pharmacia Pharmalytes (Pharmacia Inc. Uppsala, Sweden). Gels were prefocused for 30 minutes at constant current of 3 milliamps using a Pharmacia Flat Bed Apparatus FBE-3000, Pharmacia 3000/150 power supply and a Sargent water bath cooler (E.H. Sargent & Co., Chicago, ILL). Samples were loaded onto gel surface using Pharmacia applicator strips, 20ul per extract, and focused for 1.5-2 hours at 3 milliamps.

Focused extracts were transferred to 0.45 nitrocellulose paper (Schleicher and Schuell, Keene, NH) by the method of Towbin, et al. (1979) using a Bio-Rad Trans-Blot cell, 250/2.5 power supply (Bio-Rad Laboratories, Rockville Centre NY) and Sargent Cooling Bath. Blotting was carried out in 0.7% acetic acid at 100 volts for 3 hours.

To detect allergens, a human serum pool was collected from 118 patients with 3 or 4+ prick test reactions to a commercial *Alternaria* extract. *Alternaria* allergens were detected on the immunoblots using methods described by Turner, et al. (1983) and Kroutil, et al (1987). Briefly, focused extracts on nitrocellulose were washed for 30 minutes in buffer containing 0.1% gelatin to block remaining protein binding sites, and incubated overnight with the specific IgE-containing human serum pool. After washing, the blots were incubated for 4 hours with monoclonal mouse anti-human IgE, followed by 4 hours in alkaline phosphatase-labelled goat anti-mouse IgG (Atlantic Antibody, Charles River Co., Scarborough ME) and developed in fast blue and naphthol magnesium sulfate.

TABLE I. *Alternaria* isolates:

1.	A1000	*A. alternata*-like, but not a perfect match to Simmons' reference strains
2.	A1002	not *A. alternata*;
3.	A1004	*A. alternata*.
4.	A1005	not *A. alternata*
5.	34-016	*A. alternata* (E. G. Simmons)
6.	34-039	*A. alternata* "
7.	35-056	*A. alternata* "
8.	35-193	*A. alternata* "
9.	38-066	*A. alternata* "

RESULTS

Initial comparisons between culture media and between concentrated, frozen vs lyophilized extract preparations of *Alternaria* isolate A1005 revealed essentially identical allergen profiles by the methods described above encouraging comparison among concentrated, frozen extracts and lyophilized preparations of other strains.

A total of 32 different allergens were visualized in spore extracts from the four random isolates with all batches and strains combined (figure 1): 23 in the range pH 3.00-6.57 and 9 in the 6.57-10.00 range. In the five stable *A. alternata* strains studied, 18 allergens were detected, 15 between pH 3.00-6.57 and three between pH 6.57-10.00 (figure 2).

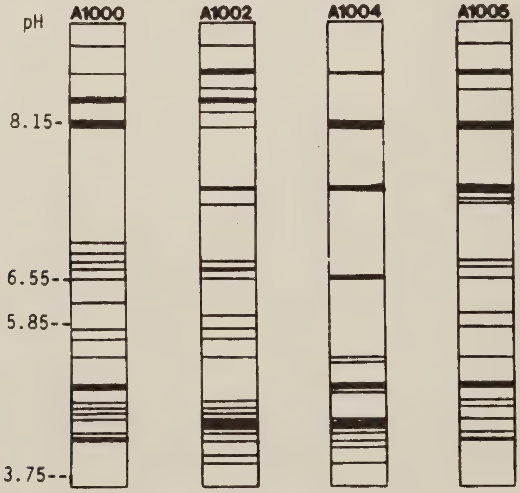

Figure 1. Comparison of IgE Immunoblots from four random *Alternaria* strains.

Batch to batch variability is displayed in figure 3 in immunoblots from random isolate A1002 (the most allergen rich and least variable random isolate). Figure 4 displays immunoblots of 3 extraction batches each for the most allergen rich (35-193) and for the least variable (34-016) of the stable Simmons isolates.

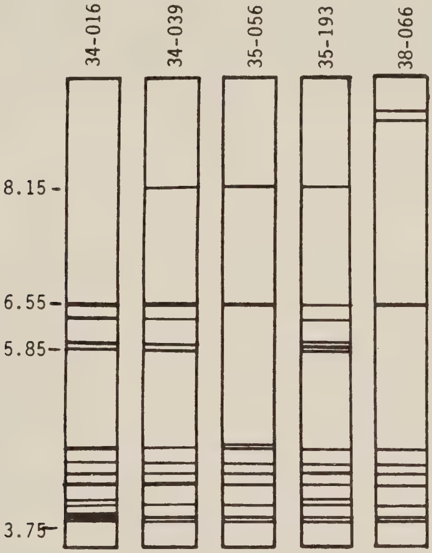
34-016
34-039
35-056
35-193
38-066
8.15
6.55
5.85
3.75

Figure 2. Comparison of IgE Immunoblots from five stable *A. alternata* strains.

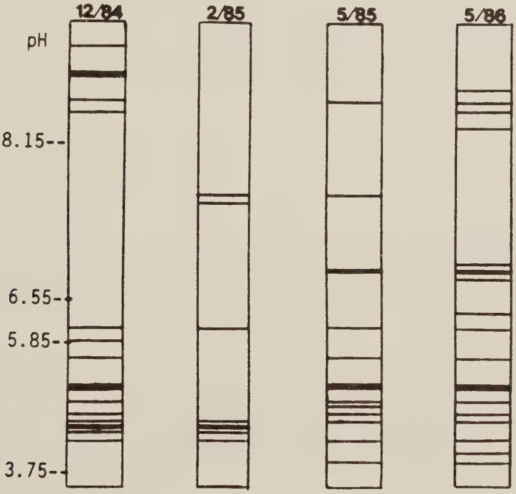
12/84
2/85
5/85
5/86
pH
8.15
6.55
5.85
3.75

Figure 3. IgE Immunoblot variability in strain A1002.

Considering all extractions, five allergens were demonstrated in all four random strains, but no single allergen was present in all batches. No single strain of these 4 was more allergenically stable than the others during the less than 18 month period in which extractions were made. With all spore batches combined, A1002, the most allergenically complete isolate, still lacked 19% (6/32) of qualitatively identified allergens. A1004 had the most incomplete allergen profile, missing 53% (17/32) of the demonstrated spore allergens.

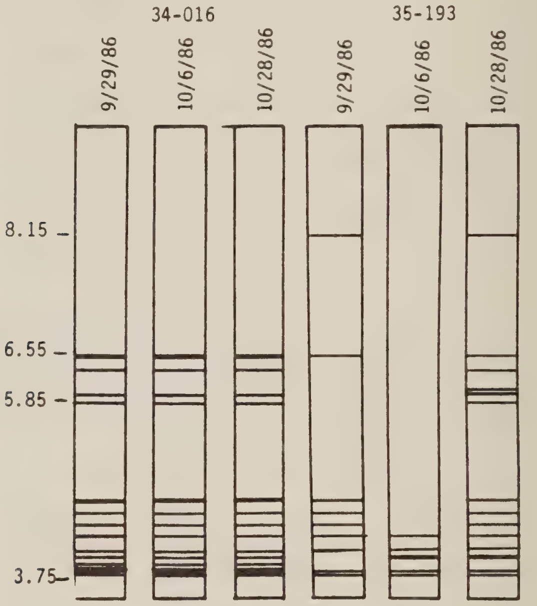

Figure 4. IgE Immunoblot variability in two stable *Alternaria* strains.

The two strains that correctly represent *A. alternata* (A1000 and A1004) differed from each other as much as from the two *Alternaria* strains misidentified as *A. alternata*.

Five allergens were also present in all five of the stable strains, four of which corresponded to four of the 5 allergens consistently present in the random isolates. Except for the 10/6/86 batch of strain 35-193, these allergen bands were conserved in every batch of each strain. All batches of 34-016 were allergenically identical. Each of the other Simmons strains had at least one batch which was deficient in three or more allergens other than the five above.

Of the five allergens conserved for each group of strains studied, four of these were probably present in all nine strains, and all of these had migrated in the pI range below 6.57.

DISCUSSION

These findings emphasize: 1) the danger that isolates of *Alternaria* may be incorrectly identified to form species by an observer inadequately trained in *Alternaria* taxonomy, 2) that a single randomly isolated strain of *A. alternata* may show limited allergen expression, 3) that batch to batch differences for single strains may be extremely prominent and, 4) that the use of culturally stable strains can significantly increase the reliability of recovering of expected *Alternaria* allergens.

A1002, an isolate clearly not *A. alternata*, was richest in allergens recognized by "*Alternaria*-sensitive" sera, and, it appears from figures 1 and 3 that the random isolates produced more allergen bands than the culturally stable strains. Preliminary work in our laboratory comparing spore and mycelial preparations indicates that these differences may be due to the higher percentage of mycelium present in the preparations from the random isolates. While every possible attempt was made to exclude mycelium from the preparations, many of the random isolate spores had begun germination either before or during harvest, and the random isolate cultures were more mycelial than the stable strains. It is worth noting that, although spores are the intuitively obvious unit of fungus exposure for most of the population, significant levels of hyphal fragments do occur in air and that allergen activity not shared by spores does appear to be present in mycelium.

The diagnosis and treatment of clinical mold sensitivities has been difficult and, it seems, often better approached by environmental control rather than by immunologic approaches. Methods of allergen preparation based on experience with field collected, easily recognized, and relatively stable plant materials (e.g. ragweed pollen) have not transferred well to fungus materials which can seldom be field collected, are identifiable only by a few specialists, and tend to be pleomorphic and biochemically variable in time (Burge, 1985). Until recently, potential interference resulting from these confounding factors has not been recognized (Helm, et al. 1987). The intrusion of non-medical mycologists into the field of allergy has at least served to alert those doing research on fungus allergens to possible dangers. It is apparent that before the true role of the fungi in human allergic disease can be accurately assessed, methods based on a solid grounding in fungus taxonomy, physiology and biochemistry will have to be developed. This will only be possible when medical researchers become willing to rely on mycological experts, and when students of mycology are willing to become involved in this important and exciting field.

ACKNOWLEDGEMENTS

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THAXTEROGASTER THIERSII: A NEW SECOTIOID SPECIES FROM CALIFORNIA

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SUMMARY

Thaxterogaster thiersii sp. nov is described from the coast of Northern California. It is compared to two similar species: *T. porphyreum* (Cunningham) Singer, which is known only from New Zealand, and *T. conicum* (Hesler) Singer & Smith of the eastern U.S.

INTRODUCTION

This new secotioid species was discovered during a six year survey of the macroscopic fungi of Audubon Canyon Ranch, a 1000 acre nature preserve located in Marin County at the edge of the Bolinas Lagoon. It was collected in a successional mixed evergreen forest habitat at an altitude of approximately 100 feet, and it is distinguished from related taxa by significant macroscopic and microscopic features as well as by distribution.

THAXTEROGASTER THIERSII *sp. nov.* FIGS. 1, 2A, 2C, 3

Gasterocarpi stipitato-pileati. Pileus 2.8-3.5 cm altus, subglobosus vel pyriformis, undulatus, margine incurvato et stipitem affixo, superficie viscida pallida, cristis partem violaceo-tinctis, sulcis pallido-griseo-aurantiaco-tinctis. Gleba loculata, brunneo-aurantiaca, loculis 0.2-1.5 mm longis. Stipito-columella nonnunquam percurrens, parte excurrenti brevi, apicem versus ramificans, laminas tramae radiantes formans, superficie sicco, violaceo. Contextus pallido-albus. Hyphae peridii 2-6 μm latae, tramae (4)6-10(12) μm latae. Basidia (32)40-50(65) × 10-15 μm, tetrasterigmata, sterigmatibus 3.5-6 × 2-3 μm, symmetricis vel semifalcatis, apicalibus vel subapicalibus. Basidiosporae (12.5)14-16.5(18) × 10-12(13) μm, late ellipsodeae, subsymmetricae vel symmetricae, grosse verrucosae, cinnamomeo-brunneae, appendice hili brevi, hyalina. Fibulae nullae. Subhypogeus sub Querco agrifolia et Pseudotsuga menziesii. Holotypus: C. J. Calhoun 80-1475, 20 Jan 1980, Audubon Canyon Ranch, Marin Co., California (SFSU).

Gasterocarps stipitate-pileate. *Pileus* 2.8-3.5 cm tall, 3-4 cm broad, subglobose to pear-shaped, undulate, margin curving in toward and remaining attached to stipe; surface viscid, glabrous, pallid, ridges partly violaceous-tinged, furrows with pale grayish-orange tints. *Gleba* loculate, chambers irregular, 0.2-1.5 mm in the longest dimension, colored brownish-orange (5C4, Kornerup & Wanscher, 1978), unchanging on exposure or injury, maturing first near stipe-columella apex, drying cinnamon-brown. *Stipe-columella* well-developed, widest below (8-15 mm), tapering upwards, percurrent or not, ±ramifying toward apex into radiating tramal plates; context solid, white-pallid, unchanging on exposure, violaceous-tinged where damaged by insect larvae, stipe portion relatively short, narrowing somewhat toward base; surface dry, glabrous, violaceous. *Odor* not distinctive, *taste* not recorded.

Peridium about 250 μm thick, composed of hyaline, loosely organized, filamentous hyphae, 2-6 μm wide, lying ±parallel to the surface within and below a gelatinous matrix; hyphae of the peridium trama up to 12 μm wide, some with gold-colored encrustations; hyphae of tramal plates (4)6-10(12) μm wide, subparallel, smooth, hyaline. Oleiferous hyphae present in trama, common in mature gasterocarps, 2.5-6 μm wide, even or gnarled, hyaline to cinnamon-brown when revived in 3% KOH. *Basidia* (32)40-50(65) × 10-15 μm, mostly clavate, 4-spored, with sterigmata 3.5-6 × 2-3 μm, symmetric to semifalcate, apical to subapical. *Pleurocystidia* and *cheilocystidia* absent. *Basidioles* present, 20 μm wide. *Basidiospores* (12.5)14-16.5(18) × 10-12(13) μm, broadly ellipsoid, axially subsymmetric to symmetric, thick-walled, coarsely verrucose, cinnamon-brown, with a short, hyaline hilar appendage. *Stipe hyphae* subparallel, smooth, hyaline. *Clamp connections* absent in all tissues.

Subhypogeous. Collected in mixed woods under *Quercus agrifolia* Neé and *Pseudotsuga menziesii* (Mirb.) Franco.

TYPE: U.S.A. California. MARIN CO.: Audubon Canyon Ranch, 20 Jan 1980, *C. J. Calhoun 1475* (HOLOTYPE: SFSU).

Additional material examined: U.S.A. California. MARIN CO.: Audubon Canyon Ranch, *C. J. Calhoun 80-1447*, *80-1603* (SFSU).

DISCUSSION

Thaxterogaster thiersii belongs in section *Aporpogaster* Singer & Smith (Singer & Smith, 1963). It is distinguished macroscopically by the following combination of characters: a subglobose to pear-shaped pileus with a gently undulating surface and a margin that remains attached to the stipe-columella throughout development; a moderately viscid, pallid-colored, glabrous peridium with light violaceous and pale grayish-orange tints; a finely loculate, brownish-orange gleba which matures first near the stipe-columella apex; a dry, light violaceous-colored, relatively short stipe proper. Distinctive microscopic characters include: the broadly ellipsoid, often axially subsymmetric, coarsely verrucose, cinnamon-brown-colored spores with thick exosporium; basidia up to 65 μm long, with prominent, apically to subapically attached, straight to ±curved sterigmata that are often 6 μm long; the absence of clamp connections from all tissues.

In combination, the macroscopic and microscopic characters of *T. thiersii* distinguish it from the other species in section *Aporpogaster*, namely *T. porphyreum* and *T. conicum*. The following discussion includes observations published by Singer & Smith (1958). *Thaxterogaster porphyreum* (illustrated in Cunningham, 1942) occurs in association with *Nothofagus* species in New Zealand and has a

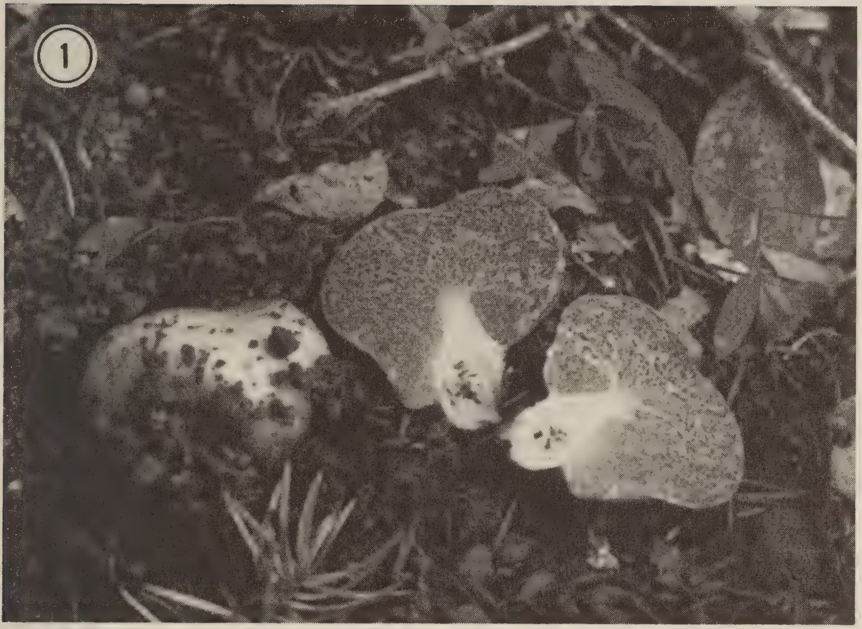

Fig. 1. Carpophores of *Thaxterogaster thiersii* (HOLOTYPE), approx. × 1.

globose to globose-depressed pileus with a viscid violaceous-colored peridium. Macroscopically, *T. porphyreum* differs from *T. thiersii* in several other respects: the peridium is more highly pigmented; the stipe is comparatively long; the columella, which is often partly free from the gleba, always extends to the apex of the pileus; the context of the peridium, stipe, and columella is light lilac-colored. Some microscopic differences are: the spores of *T. porphyreum* are narrower [(7.5)9-11 µm (Figs. 2A, 2B)], coarsely verruculose (Cunningham, 1924) with thin epispore, and are mostly axially symmetric; the basidia are 22-32 × (6)10-11 µm; clamp connections are present in *T. porphyreum* (Horak & Moser, 1965). *Thaxterogaster conicum* occurs from Ohio to Tennessee, U.S.A., and is found on the ground under *Quercus* sp. and *Pinus echinata* Mill. Gasterocarps of *T. conicum* are "apparently" always fully epigeous at maturity, and the species is considered to be the most agaricoid of the genus. Furthermore, they are generally much larger than those of *T. thiersii*, and typically have an elongate, conic pileus. Illustrations that show the distinctive stature of *T. conicum* appear in Hesler (1933) and Singer & Smith (1958). In contrast to *T. thiersii*, the peridium of *T. conicum* is innately white-silky-fibrillose, and colored grayish-pallid to grayish-ochraceous with a darker disk that becomes tinged violaceous on exposure; a white arachnoid veil is present; the pileus margin separates early along the entire length of the stipe-

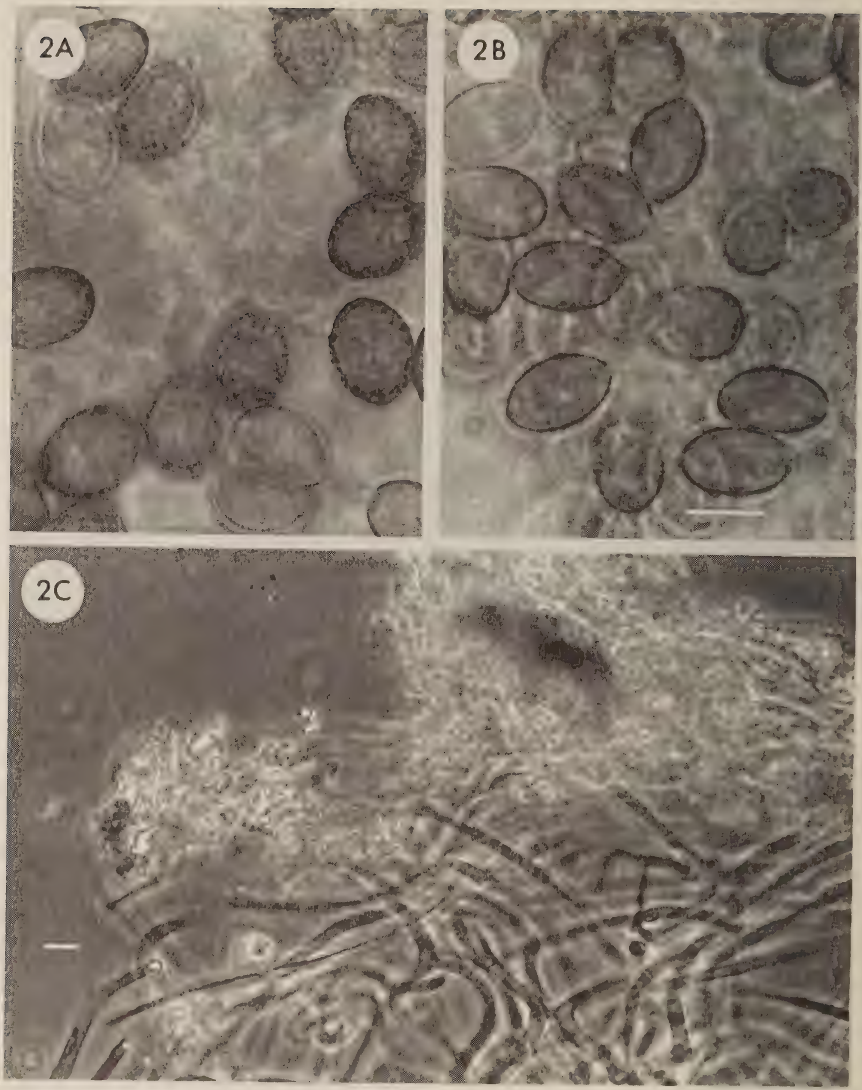

Fig. 2. Spores from *Thaxterogaster thiersii* (HOLOTYPE), (A), photographed at same magnification as B. (B). *Thaxterogaster porphyreum*, Cunningham 923 (SYNTYPE). (C). Cross section of peridium from *T. thiersii* (HOLOTYPE), showing gelatinous matrix and simple septate hyphae. Scale bars = 10 μm.

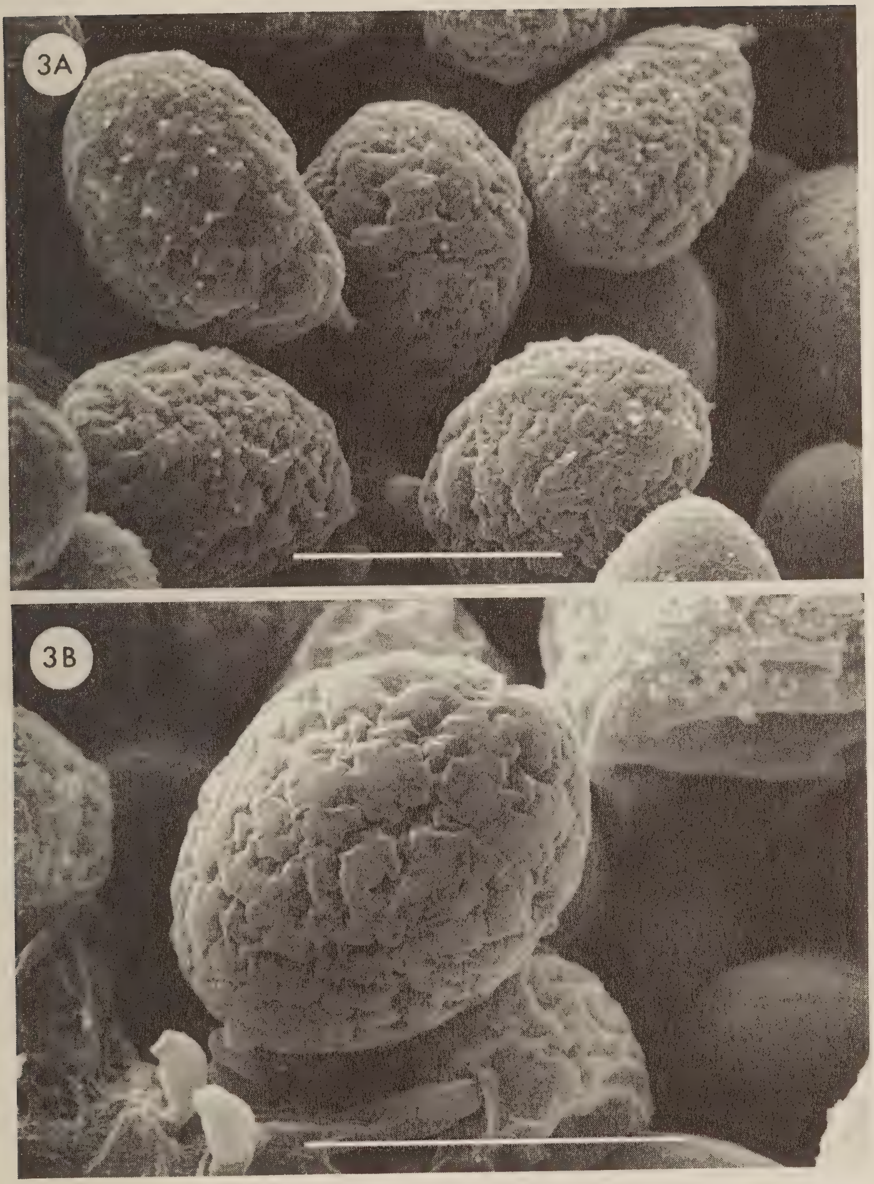

Fig. 3. Scanning electron micrographs, basidiospores of *Thaxterogaster thiersii* (HOLOTYPE). In (A) note hilar appendages. Prominent sterigmata are seen at lower left in (B). Scale bars = 10 μm.

columella, exposing the gleba; the gleba is coarsely loculate (up to 10 mm long) with a lamellate development. The verrucose to warty spores of *T. conicum* reach 20 μm and are ellipsoid, while mature spores of *T. thiersii* rarely reach 18 μm and are broadly ellipsoid. The basidia of *T. conicum* are 32-40 × 6-16.5 μm, while the majority of basidia are 42-50 × 12-14 μm in *T. thiersii*. Hyphae in the trama of the peridium of *T. conicum* measure up to 22 μm wide, but only reach 12 μm in *T. thiersii*.

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STUDIES ON MARASMIUS FROM EASTERN NORTH AMERICA. II. NEW SPECIES

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ABSTRACT

Four new taxa in *Marasmius* are described as new: *M. ilicicola* (sect. *Marasmius*), *M. ciliatomarginatus*, *M. paludigenus* and *M. falcatipes* (sect. *Sicci*). All taxa are illustrated and compared to phenetically similar taxa.

Key Words. *Marasmius ilicicola, Marasmius ciliatomarginatus, Marasmius paludigenus, Marasmius falcatipes.*

Although significant contributions have been made toward understanding of the genus *Marasmius* as it occurs in the northeastern United States (Morgan, 1905, 1906; Pennington, 1915; Gilliam, 1975a, 1975b, 1976; Halling, 1983) and western United States (Desjardin, 1985, 1987a, 1987b), no comprehensive taxonomic treatment of the genus from the southeastern United States is available. During the course of preparing a floristic monograph of *Marasmius* from southeastern North America, extensive herbarium studies and field work have uncovered several new taxa.

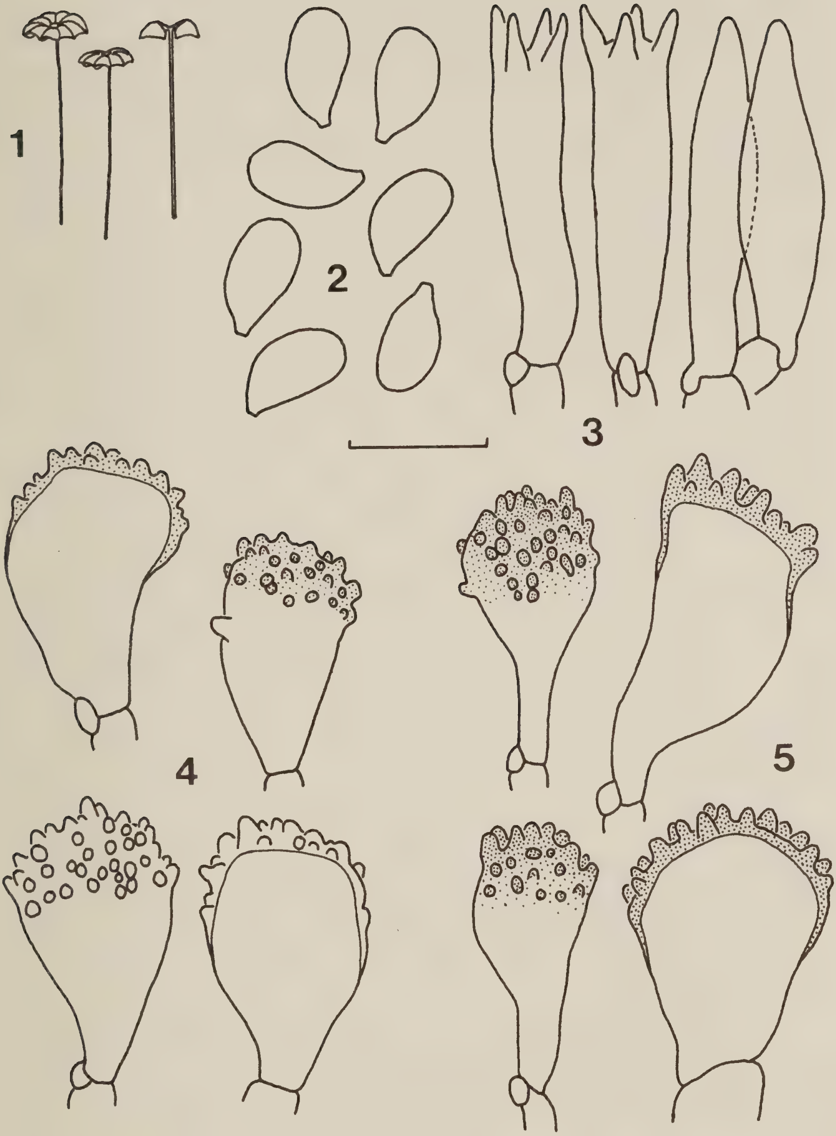
Color terms and notations are from Kornerup and Wanscher (1978). In the sections on material examined, commonly used abbreviations are as follows: GSMNP, Great Smoky Mountains National Park; DED, D. E. Desjardin.

Where five or more specimens of each taxon were available for a comparison of intraspecific variation, we have followed the suggestion of Parmasto and Parmasto (1987: 111) and calculated the 90%-expected tolerance limits of the mean spore size at 90% probability level [TL90(90%)]. Other spore factors determined include: $\bar{x}$, the arithmetic means of the spore length (L) and spore width (W) in a sample (specimen); $\bar{\bar{x}}$, the mean of means where more than one specimen is available; s, standard deviation of a sample (indicated as sL X sW, and sQ), *or* standard deviation of the mean values where more than one specimen is available; E, the quotient of L and W in any one spore (indicated as a range of variation in n spores measured); Q, the mean of E-values in a sample; $\bar{Q}$, the mean of Q-values where more than one specimen is available.

MARASMIUS ILICICOLA Desjardin *sp. nov.* Figs. 1-5.

Pileus 2-4 mm latus, convexus, sulcatus, umbilicatus, subvelutinus, disco atrobrunneus, margine pallidior. Lamellae adnatae, distantes, latae, collariatae, pallidae. Stipes 10-22 mm longus, 0.1-0.2 mm crassus, filiformus, glaber, insititius, atrobrunneus; rhizomorphae atrae. Odor et sapor nullus. Basidiosporae 7.5-9.5 X 3.5-4.8 µm, amygdaliformes, laeves, hyalinae, inamyloideae. Basidia tetraspora. Pleurocystidia nulla. Cheilocystidia elementis pileipellis similia. Pileipellis hymeniformis ex elementis *M. rotali* similibus; diverticuli pallidobrunnei. Trama ex hyphis inamyloideis, fibulatis. In foliis *Ilicis opacae*. **Holotypus**: Mississippi, De Soto National Forest, Perry Co., Black Creek Wilderness Area, 16 Jul 1987, D. E. Desjardin no. 4355 (no. 47625, TENN).

Basidiomata (Fig. 1) marcescent, reviving. **Pileus** 2-4 mm broad, convex, sulcate, centrally depressed, with or without a broad, low papilla; surface dull, dry, opaque, subvelutinous; central depression or papilla dark brown (6-7F4-8) throughout maturation; margin evenly light brown (6D4-5) when young, remaining so in age or fading to greyish orange (5B4), lacking a whitish zone surrounding the dark central dot; context thin, concolorous with adjacent cuticle. **Lamellae** distant (9-11 reach the collarium), broad, adnate to a complete, free collarium, pale orange white (5A2) when young, becoming pale brownish orange (5B3-5C4) in age, collarium and lamellar edges concolorous with lamellar faces or darkening slightly when



Figs. 1-5. Features of **Marasmius ilicicola** [Desjardin 4355, Holotype]. 1. Basidiomata (X3). 2. Basidiospores. 3. Basidia and basidioles. 4. Cheilocystidia. 5. Pileipellis elements. Scale bar = 10 µm.

dried, lamellulae absent. **Stipe** 10-22 X 0.1-0.2 mm, terete, equal, filiform, hollow, shining, glabrous, insititious; apex concolorous with lamellae, base dark brown (6F4-8), darkening overall in age. **Rhizomorphs** scattered, wiry, black, basidiomata not arising from the rhizomorphs. **Odor** and **taste** not distinctive.

Basidiospores (Fig. 2) 7.5-9.5 X 3.5-4.8 µm [$\bar{x}$ = 8.3 X 4.3 µm, s = 0.43 X 0.26; E = 1.8-2.1; Q = 1.9, sQ = 0.1; n = 30], ellipsoid or amygdaliform, hyaline, inamyloid. **Basidia** (Fig. 3) 22-26 X 5.5-6.5 µm, cylindric or subclavate, 4-spored. **Basidioles** (Fig. 3) fusoid. **Pleurocystidia** absent. **Cheilocystidia** (Fig. 4) numerous, similar to pileipellis elements, 16-20 X 8.5-12 µm, hyaline overall or apically pale ochraceous, inamyloid. **Pileipellis** a hymeniform layer of *Rotalis*-type elements (Fig. 5), 17-25.5 X 9-16(-20) µm, broadly clavate or sphaeropedunculate, apically pale brown and thick-walled, basally hyaline and thin-walled, diverticula -1.6 X -1.2 µm, numerous, apical and subapical, knob-like, solid, pigmented portions inamyloid or weakly dextrinoid, unpigmented portions inamyloid; some scattered elements slightly thicker-walled and more deeply pigmented than average giving the pileipellis a weakly mottled appearance under low magnification. **Pileal** and **lamellar tramal hyphae** interwoven, 2.5-8 µm diam, hyaline, smooth or weakly granular-incrusted, inamyloid. **Stipe cortical hyphae** parallel, 2.5-6.5 µm diam, hyaline to pale ochraceous at the stipe apex, deep olivaceous brown in KOH at the stipe base, with dextrinoid walls up to 1 µm thick. **Stipe medullary hyphae** parallel, 2-8 µm diam, hyaline, inamyloid, thin-walled. **Caulocystidia** absent. **Clamp connections** common on tramal hyphae and hymenial elements.

HABIT, HABITAT AND DISTRIBUTION. Scattered on senescent leaves of *Ilex opaca* Ait. in mixed bottomland hardwoods with scattered pines. Mississippi. July. Locally abundant.

MATERIAL EXAMINED. UNITED STATES. MISSISSIPPI: De Soto National Forest, Perry Co., Black Creek Wilderness Area, 16.vii.87, DED no. 4355 (no. 47625, TENN - **Holotype**).

OBSERVATIONS. *Marasmius ilicicola* belongs in sect. *Marasmius*, subsect. *Pararotulae* (Sing.) Sing. because of the presence of collariate lamellae, insititious stipe and *Rotalis*-type pileipellis elements. It is microscopically similar to several neotropical taxa, *viz. Marasmius scototephrodes* Sing. from Mexico, and *M. tetrachrous*

Sing. from Bolivia. *Marasmius scototephrodes* differs in having an ash grey pileus with a whitish zone surrounding a grey central dot, dark greyish-marginate lamellae and fruiting habit on sticks and leaves of various dicotyledonous plants but not on *Ilex* [**Holotype:** Singer M8299 (F!)]. *Marasmius tetrachrous* differs by forming smaller (1.5-2 mm diam), bullet-shaped, ferruginous pilei with a pallid zone surrounding a dark central dot, in having shorter and broader basidia and in lacking rhizomorphs (*fide* Singer, 1976). In eastern North America, *M. ilicicola* is superficially similar to *M. capillaris* Morg., in that both species form basidiomes with brownish, sulcate pilei, collariate lamellae and dark filiform stipes accompanied by rhizomorphs. *Marasmius capillaris* differs, however, in forming pilei with a buff or pale yellowish zone surrounding the central depression, in having more numerous and more closely spaced lamellae and by growing on leaves of *Quercus* species or rarely on coniferous needles [**Lectotype:** Morgan, Oct. 1890 (ISC!)]. Of the nearly 100 herbarium collections of *M. capillaris* we have studied, no basidiomes were observed growing from leaves of *Ilex*. Field studies also support these data. In areas where *Ilex opaca* and *Quercus* spp. are sympatric, extensive searches for *M. capillaris* on *Ilex* and *M. ilicicola* on substrates other than *Ilex* have proved unsuccessful. See Gilliam (1976) for a description of *M. capillaris*.

If the collarium is overlooked, *M. ilicicola* might be confused with another macroscopically similar *Ilex* leaf-degrading taxon, *viz. M. ilicis* Singer. The latter differs microscopically in having ventricose or lageniform pleurocystidia, thick-walled dermatocystidia similar in shape to the pleurocystidia and interspersed among *Rotalis*-type pileipellis elements, and in having diverticulate stipe cortical hyphae [**Isotype:** Singer B88 (MICH!)]. See Singer (1953) for a description of *M. ilicis*.

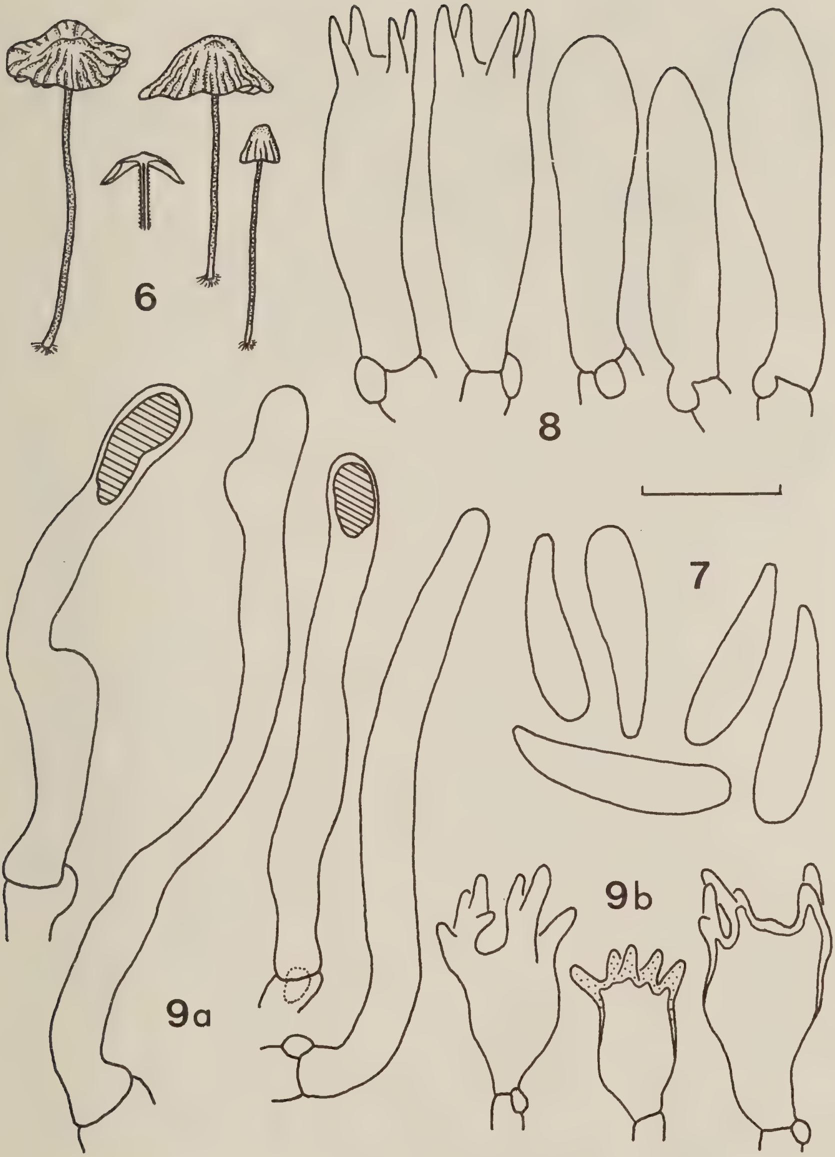
Although *Ilex opaca* (American Holly) is common throughout the southeastern United States and ranges northward into coastal Massachusetts (Elias, 1980), *M. ilicicola* is known at present only from coastal Mississippi. It is presumed that the high summer temperatures and humidity plus mild winter temperatures and abundant rainfall characteristic of the gulf coast region are important determining factors in the distribution of *M. ilicicola*.

MARASMIUS CILIATOMARGINATUS Desjardin *sp. nov.* Figs. 6-11.

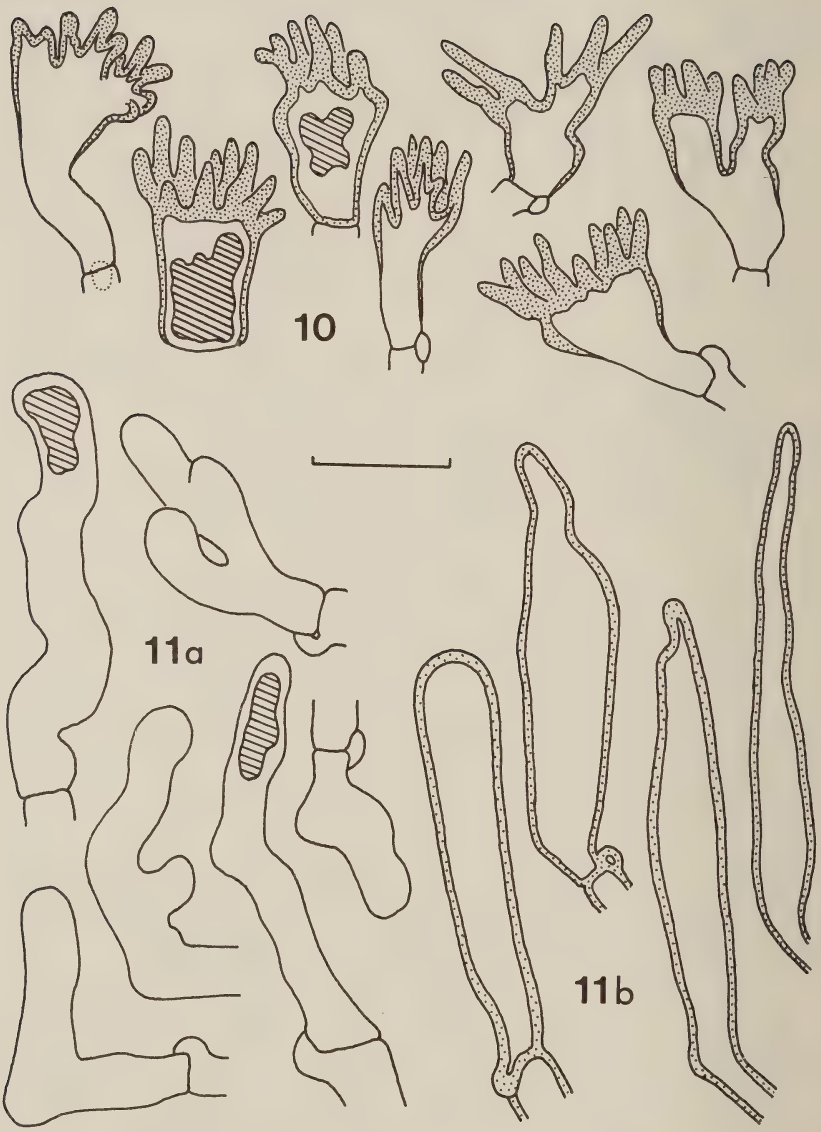
Pileus 5-20 mm latus, campanulatus vel plano-convexus, ruguloso-striatus, subvelutinus, badius vel ferrugineus. Lamellae adnatae, subdistantes, angustae, alboluteae, ferrugineus-marginatae. Stipes 18-45 mm longus, 0.5-1 mm crassus, teres, aequalis, pubescens, non insititius, apice bubalinus, base brunneus, aetate atrans. Odor et sapor nullus. Basidiosporae 13.5-18 X 3.2-4.7 µm, clavatae, laeves, hyalinae, inamyloideae. Basidia tetraspora. Pleurocystidia nulla. Cheilocystidia cylindrica vel flexuosa, gleocystidiodea, contentibus cinnabarinis, rariter elementis pileipellis similia. Pileipellis hymeniformis ex elementis *M. sicco* similibus; diverticuli ferruginei. Trama ex hyphis dextrinoideis, fibulatis. Caulocystidia cheilocystidiis gleocystoideis similia. Ad folia dejecta dicotyledonum. **Holotypus:** North Carolina, Macon Co., Highlands, Horsecove, 10 Aug 1987, D. E. Desjardin no. 4414 (no. 47626, TENN).

Basidiomata (Fig. 6) marcescent, reviving. **Pileus** 5-20 mm broad, conic or campanulate when young, expanding in age to broadly campanulate or plano-convex, often with a low umbo and upturned margin; surface dull, dry, opaque, subvelutinous; disc rugulose, margin rugulose-striate; context thin, buff; color reddish brown (8D6-8), brown (7E7-8) or deep orange brown (7D8) overall when young, disc remaining so in age or fading to brownish orange (7C7-8), margin soon becoming brownish orange and fading in age to light brownish orange (6C5-7) or rarely when old and wet becoming light orange (5A3-4). **Lamellae** adnate, subdistant to nearly close (20-25 reach the stipe), narrow (<1.5 mm), yellowish white or cream (4A2-3), seldom forked near the margin, interlamellar spaces sometimes venose and assuming pileus tints at maturity; edges granular-crystalline, pale-concolorous with the pileus; lamellulae in 0-2 series. **Stipe** 18-45 X 0.5-1 mm, terete, equal or seldom with a small subbulbose base, pruinose to pubescent overall, arising from a small ring of buff or cream-colored mycelium; when young, upper half yellowish white (4A2) to dingy buff, lower half brown (6E5-6), hysterochroic, in age upper few mm pallid, base brown (6-7E4-6), reddish brown (8E5-6) or dark brown (7F5-6). **Odor** and **taste** not distinctive.

Basidiospores (Fig. 7) 13.5-18 X 3.2-4.7 µm [$\bar{\bar{x}}$ = 15.7 X 4 µm, s = 0.95 X 0.26; E = 3-4.6; $\bar{Q}$ = 3.9, s$\bar{Q}$ = 0.29; n = 30/3 collections], clavate or fusiform-elliptical, often



Figs. 6-9. Features of **Marasmius ciliatomarginatus** [Desjardin 4414, Holotype]. 6. Basidiomata (X1). 7. Basidiospores. 8. Basidia and basidioles. 9a. Gloeocystidioid cheilocystidia. 9b. *Siccus*-type cheilocystidia. Scale bar = 10 µm.



Figs. 10-11. Features of **Marasmius ciliatomarginatus** [Desjardin 4414, Holotype]. 10. Pileipellis elements. 11a. Caulocystidia from stipe apex. 11b. Caulocystidia from stipe base. Scale bar = 10 µm.

curved in profile, hyaline, inamyloid. **Basidia** (Fig. 8) 22-30 X 6.5-8.5 µm, subcylindric or clavate, 4-spored. **Basidioles** (Fig. 8) clavate, ventricose or fusoid. **Pleurocystidia** not differentiated. **Cheilocystidia** of two types: 1) numerous gloeocystidioid elements (Fig. 9a), 38-56 X 3-5 µm, cylindric, flexuous or strangulate, obtuse, thin-walled, with or without tawny to reddish orange globular cytoplasmic contents typically congregated nearest the apices of the cells, or with reddish orange globular masses adherent to the external cellular surfaces, walls inamyloid; 2) rare (or absent), scattered *Siccus*-type elements (Fig. 9b) similar to pileipellis elements, with hyaline or pale orange diverticula. **Pileipellis** a hymeniform layer of *Siccus*-type elements (Fig. 10), with rare, inconspicuous, clavate, thin-walled, non-diverticulate cells interspersed; *Siccus*-type elements 8-16 X 3.2-8 µm, cylindric, clavate or irregular in outline, sometimes lobed, thin- to thick-walled, hyaline or tawny-colored; diverticula 1.5-8 X 0.8-2 µm, apical, irregularly conic or cylindric, subnodulose or not, thick-walled or solid, ochraceous or reddish brown, pigmented portions weakly dextrinoid; some elements with tawny, globular contents; some elements thicker-walled and more deeply pigmented than average giving the pileipellis a mottled appearance under low magnification. **Pileal** and **lamellar tramal hyphae** interwoven, 1.5-9 µm diam, cylindric or inflated, branched, hyaline, non-incrusted, inamyloid or weakly dextrinoid, thin-walled. **Stipe cortical hyphae** parallel, 2.5-6 µm diam, dextrinoid, hyaline or pale ochraceous and thin-walled apically, ochraceous or brown and thick-walled below. **Stipe medullary hyphae** parallel or subparallel, 2.5-11 µm diam, hyaline or pale yellowish, inamyloid or weakly dextrinoid. Highly refractive oleiferous hyphae common. **Stipe vesture** of abundant **caulocystidia:** at stipe apex (Fig. 11a) 13-32 X 3-5 µm, irregularly cylindric or strangulate-contorted, rarely lobed, obtuse, hyaline, inamyloid, thin-walled, with or without reddish orange globular contents or adherent exudates; at stipe base (Fig. 11b) -40 X 4-8 µm, cylindric to ventricose or acuminate, pale ochraceous, inamyloid, walls -1.2 µm thick. **Clamp connections** common throughout basidiomata.

HABIT, HABITAT AND DISTRIBUTION. Scattered to gregarious on senescent hardwood leaves or stems (rarely on *Rubus* stems or hickory nuts) in mixed woods containing *Liriodendron, Quercus, Alnus, Cornus, Carya* and *Ilex* with scattered *Pinus* and *Tsuga*. Aug. - Sept. Uncommon. NC, TN.

MATERIAL EXAMINED. UNITED STATES. NORTH CAROLINA: Macon Co.: Highlands, Horsecove, 10.viii.87, DED no. 4414 (no. 47626, TENN - **Holotype**). TENNESSEE: Blount Co.: GSMNP, Cades Cove, 31.viii.86, DED no. 4078 (no. 47628, TENN); Knox Co.: Knoxville, 7.ix.86, DED no. 4154 (no. 47627, TENN).

OBSERVATIONS. Features which in combination are diagnostic for *M. ciliatomarginatus* include: a) reddish brown or brownish orange, rugulose-striate pileus; b) subdistant, narrow, cream-colored, orange-marginate lamellae; c) pubescent, apically pallid and basally brownish, non-insititious stipe; d) clavate spores averaging 15.6 X 4 µm; e) absence of pleurocystidia; f) flexuous cheilocystidia with reddish orange contents or adherent exudates; and g) cylindric-contorted, non-diverticulate caulocystidia. Collectively, this diagnosis suggests placement in sect. *Sicci*, subsect. *Siccini*, ser. *Actinopodes* Singer (1976). The most distinctive feature of this species is the abundant gloeocystidioid cheilocystidia and relative absence of *Siccus*-type cheilocystidia, resulting in a lamellar edge morphology unique in section *Sicci*. Consequently, *M. ciliatomarginatus* is not likely to be confused with any other members of the section. There are, however, several North American taxa that are phenetically similar in many other respects, *viz. M. sullivantii* Mont. (widespread in eastern North America), and *M. corrugatus* var. *aurantiacus* (Murr.) Sing. (known from Florida and the neotropics).

Marasmius sullivantii differs in having much smaller spores*, abundant pleurocystidia and broom-cell-type caulocystidia [**Representative material**: DED no. 4342 (no. 47648, TENN)]. *Marasmius corrugatus* var. *aurantiacus* differs in having a glabrescent stipe with scattered broom-cell-type caulocystidia, and smaller spores* [**Holotype** of *Gymnopus aurantiacus*: Murrill, F17904 (FLAS!)]. See Gilliam (1976) and Singer (1976), respectively, for descriptions of the latter two taxa.

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*Spores of *M. sullivantii*: 6.4-8.8 X 3.2-4 µm, $\bar{\bar{x}}$ = 7.6 X 3.6 µm, s = 0.26 X 0.12; E = 1.8-2.6; $\bar{Q}$ = 2.1, s$\bar{Q}$ = 0.05; TL90(90%) = 7.1-8.1 X 3.4-3.9 µm, Q = 2-2.2; n = 30/8 specimens. Spores of *Gymnopus aurantiacus*: 7.2-9 X 3.4-4.2 µm; $\bar{x}$ = 8.2 X 3.9 µm, s = 0.47 X 0.19; E = 1.9-2.4; Q = 2.1, sQ = 0.12; n = 30.

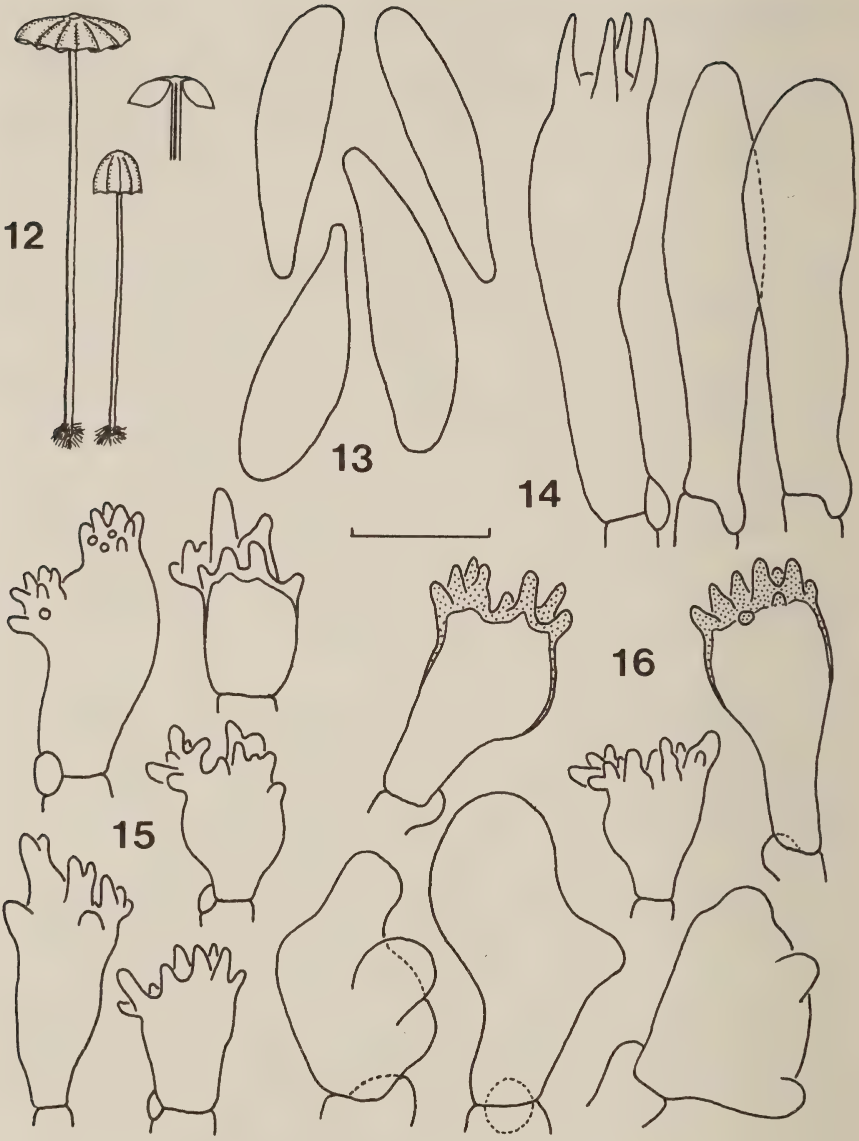
MARASMIUS PALUDIGENUS Desjardin *sp. nov.* Figs. 12-16.

Misapplied epithet: *Marasmius glabellus* Peck *sensu* Ellis, in de Thümen, Mycotheca Universalis Exsiccati Cent. 6, no. 505, 1876. *Marasmius glabellus* Peck *sensu* Ellis, in North American Fungi Exsiccati Ser. I, Cent. 10, no. 910, 1883.

Pileus 7-18 mm latus, convexus, sulcatus, subvelutinus, disco ochraceus, margine griseolo-aurantius vel alutaceus. Lamellae adnexae, remotae, latae, griseolo-aurantiae vel fusciochraceae. Stipes 20-65 mm longus, 0.5-1 mm crassus, teres, aequalis, glaber, non insititius, apice bubalinus, base brunneus, aetate atrans. Odor spermaticus. Basidiosporae 16-24 X 4.4-6 µm, clavatae, laeves, hyalinae, inamyloideae. Basidia tetraspora. Pleurocystidia nulla. Cheilocystidia elementis pileipellis similia. Pileipellis hymeniformis ex elementis latis, *M. sicco* similibus, etiam ex elementis laevibus, vesiculosis. Trama ex hyphis dextrinoideis, fibulatis. Ad folia dejecta in palustria. **Holotypus:** New Jersey, Salem Co., Camp Edge Boy Scout Camp, 18 Aug. 1987, R. E. Halling (no. 47622, TENN).

Basidiomata (Fig. 12) marcescent, reviving. **Pileus** 7-18 mm broad, obtusely conic or parabolic when young, expanding and becoming convex in age; disc rugulose, margin sulcate or plicate; surface dull, dry, opaque, subvelutinous; context thin, buff; color yellowish brown (5D5) overall when young, disc remaining so in age or fading slightly, margin fading to pale brownish orange (5C4-5) or greyish orange (5B3-4), eventually becoming tan or cream-colored (4A3). Lamellae adnexed or nearly free, remote [11-13 (rarely 16) reach the stipe], broad (2-4 mm), greyish orange (5B4-5) when young, soon becoming brownish orange (5C4-5), darkening in age to dark yellowish brown (5E-F5-6), neither forked nor intervenose; edges concolorous with the faces; lamellulae typically absent. **Stipe** 20-65 X 0.5-1 mm, terete, equal, shiny, glabrous, hollow, arising from a small pad of yellowish mycelium; white to buff above when young, brown below (6F4-8), darkening overall in age. **Odor** of crushed pilei spermatic. **Taste** not observed.

Basidiospores (Fig. 13) 16-24 X 4.4-6 µm [$\bar{\bar{x}}$ = 19.4 X 5.1 µm, s = 0.45 X 0.15; E = 3.1-4.5; $\bar{Q}$ = 3.8, s$\bar{Q}$ = 0.13; TL90(90%) = 18.5-20.2 X 4.8-5.4 µm, Q = 3.5-4; n = 30/9 specimens], clavate or fusiform-elliptical, sometimes



Figs. 12-16. Features of **Marasmius paludigenus**.
12. Basidiomata (X1) [Flynn 718]. 13. Basidiospores.
14. Basidium and basidioles. 15. Cheilocystidia.
16. Pileipellis elements. [Figs. 13-16: Halling, 18.viii.84, Holotype]. Scale bar = 10 µm.

curved in profile, hyaline, inamyloid; readily collapsing and reviving poorly. **Basidia** (Fig. 14) 25-38 X 7-8.8 µm, clavate, 4-spored. **Basidioles** (Fig. 14) clavate or ventricose. **Pleurocystidia** absent. **Cheilocystidia** (Fig. 15) abundant, 7.5-18(-25) X 4-8.8 µm, similar to the diverticulate pileipellis elements, hyaline. **Pileipellis** a hymeniform layer of versiform cells (Fig. 16), 6.5-25.5 X 4.5-12(-16) µm, irregularly cylindric, clavate, obclavate, pyriform or vesiculose, many lobed, inamyloid, with or entirely without apical diverticula; immature pilei composed mainly of diverticulate elements, basal portion of cells hyaline, thin-walled, diverticula 1-4.5 X 0.5-1.5 µm, hyaline or ochraceous, thin- or thick-walled; in mature pilei diverticulate elements abundant on the pileal disc, less frequent or rare elsewhere, pileus margin regions composed mainly of smooth, often lobed, non-diverticulate elements interspersed among tramal hyphae. **Pileal** and **lamellar tramal hyphae** interwoven, 3-9(-12) µm diam, often inflated, branched, dextrinoid, hyaline to brownish yellow; pigment soluble in 3% KOH. **Stipe cortical hyphae** parallel, 2.5-6.5 µm diam, hyaline, dark ochraceous or brown, dextrinoid, walls -1 µm thick. **Stipe medullary hyphae** subparallel, 2.5-9 µm diam, hyaline or pale yellowish, weakly dextrinoid, thin-walled. Refractive oleiferous hyphae common. **Caulocystidia** absent. **Clamp connections** common throughout basidiomata.

HABIT, HABITAT AND DISTRIBUTION. Scattered on senescent leaves or among mosses in sandy and swampy areas with *Quercus, Ilex* and *Pinus*. Aug. - Oct. Locally abundant. DE, NJ, NY, VA.

MATERIAL EXAMINED. UNITED STATES. DELAWARE: no location data, 19.viii.84, Flynn, Vilgalys & Cotter, US 900515 (BPI). NEW JERSEY: Salem Co.: Camp Edge Boy Scout Camp, 18.viii.84, R. E. Halling s.n. (no. 47622, TENN - **Holotype**). Gloucester Co.: Newfield, Ellis s.n. (BPI); Newfield, Ellis 22.vii.1875 (BPI); Newfield, Ellis, viii.1875 in de Thümen, Myco. Univ. no. 505 (as *Marasmius glabellus*) (BPI, FH, presumably other distributions); Newfield, Ellis, viii.1882, in N. Amer. Fungi no. 910 (as *M. glabellus*) (BPI, FH, MICH, NY, NYS, PENN at PH, PH, presumably other distributions). NEW YORK: Suffolk Co.: Robert Moses State Park, 28.x.84, B. M. Thiers & R. E. Halling no. 3883 (no. 47623, TENN). VIRGINIA: Northampton Co.: swamp near Norfolk, 20.viii.84, T. Flynn no. 718 (no. 47624, TENN).

OBSERVATIONS. *Marasmius paludigenus* is characterized by: 1) yellowish brown or tan, sulcate pileus; 2) remote, broad, brownish orange or dark yellowish brown lamellae; 3) glabrous, brown, non-insititious stipe; and 4) growth in swampy environments. In addition, long spores (mean length 19.4 µm), absence of pleurocystidia and caulocystidia, and pileipellis morphology are distinctive. This species was collected by J. B. Ellis "among moss in swamps" in Newfield, New Jersey on several occasions between 1875 and 1882, although Ellis determined his specimens as *Marasmius glabellus* Peck. An Ellis collection was distributed by de Thümen as no. 505 in the Mycotheca Universalis Exsiccati (issued 1876). Several years later, Ellis distributed additional material (determined as *M. glabellus*) as no. 910 in his North American Fungi Exsiccati (issued 1883). All duplicates studied of the two exsiccata numbers mentioned above represent *M. paludigenus*. *Marasmius glabellus* is similar in stature, but differs in showing a darker pileus (*i.e.*, usually retaining deep brownish orange or yellowish brown pigmentation in age and only rarely becoming pallid overall) and much paler lamellae which never develop dark yellowish brown tints as in *M. paludigenus*. Moreover, *M. glabellus* has numerous pleurocystidia, pileipelli composed entirely of *Siccus*-type diverticulate elements and smaller spores [$\bar{x}$ = 9 X 4.7 µm, s = 0.94 X 0.36; E = 1.6-2.2; Q = 1.9, sQ = 0.13; n = 30. **Holotype:** Worcester & Croghan, Peck, July & August (NYS!)]. Another southeastern representative of sect. *Sicci* with sulcate pileus, distant broad lamellae and glabrous brown stipe is *Marasmius similis* Berk. & Curt. The latter differs from *M. paludigenus* in having a whitish pileus, pileipellis elements and cheilocystidia with densely nodulose diverticula, and in forming smaller spores [$\bar{x}$ = 12.3 X 3.9 µm, s = 0.91 X 0.29; E = 2.8-3.6; Q = 3.2, sQ = 0.19; n = 30. **Isotype:** South Carolina, Society Hill, Curtis 1319 (FH!)].

An interesting feature of pileipellis morphology in *M. paludigenus* is the abundance of non-diverticulate elements in mature pilei and their relative absence in immature pilei. Indeed, in some mature basidiomata it is difficult to locate broom-cell-type elements in the pileal margin regions, whereas the entire pileipellis of immature basidiomata is formed almost exclusively of broom-cell-type elements. One might be easily misled as to the sectional disposition of this taxon if only a single tangential section of the pileus were examined. Were a hymeniform pileipellis of smooth cells present, this in combination with other basidiomata characters of *M. paludigenus*, would suggest placement in sect. *Globulares* Kühner. However, because of the abundant *Siccus*-type pileipellis elements present in young pilei and in the disc region of mature pilei, this species is accepted here in sect. *Sicci*.

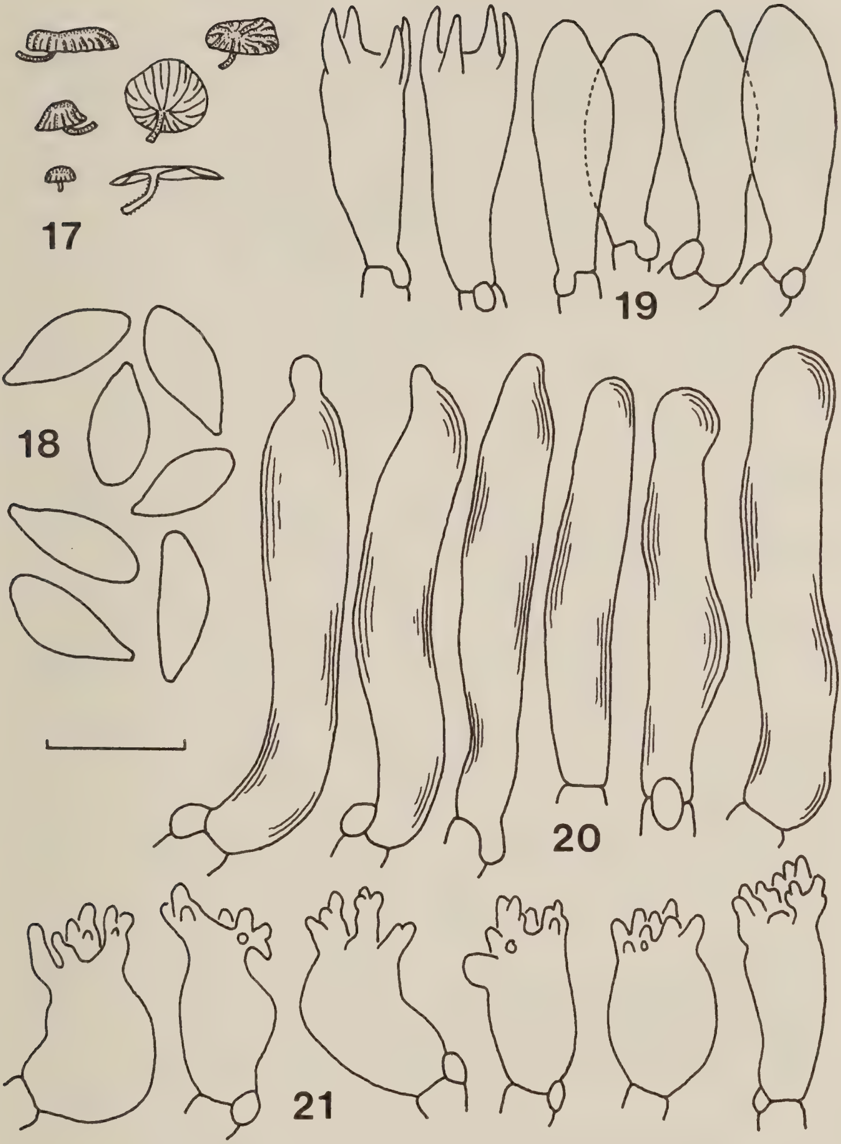
Marasmius paludigenus has many characteristics in common with *M. decipiens* Halling, Desjardin & Tish. For example, both taxa are similar in basidiomata stature, pileus shape and coloration, lamellar width and spacing, stipe coloration, spore shape, hyphal tissue amyloidity and absence of pleurocystidia. And, although the cheilocystidia and pileipellis elements of these two species are similar in shape, diverticula are altogether lacking from these structures in *M. decipiens*, an important diagnostic criterion dictating placement of *M. decipiens* in sect. *Globulares*. *Marasmius decipiens* differs also in having paler lamellae, pubescent to strigose stipe base and longer spores [$\bar{\bar{x}}$ = 22.9 X 4.6 µm, s = 0.65 X 0.12; E = 4-6; $\bar{Q}$ = 5, s$\bar{Q}$ = 0.24; TL90(90%) = 21.5-24.4 X 4.3-4.9 µm, Q = 4.5-5.5; n = 25/6 specimens. **Holotype:** Tish 1602-F (NY!)]. See Halling et al. (1985) for a description of *M. decipiens*.

MARASMIUS FALCATIPES Desjardin *sp. nov.* Figs. 17-23.

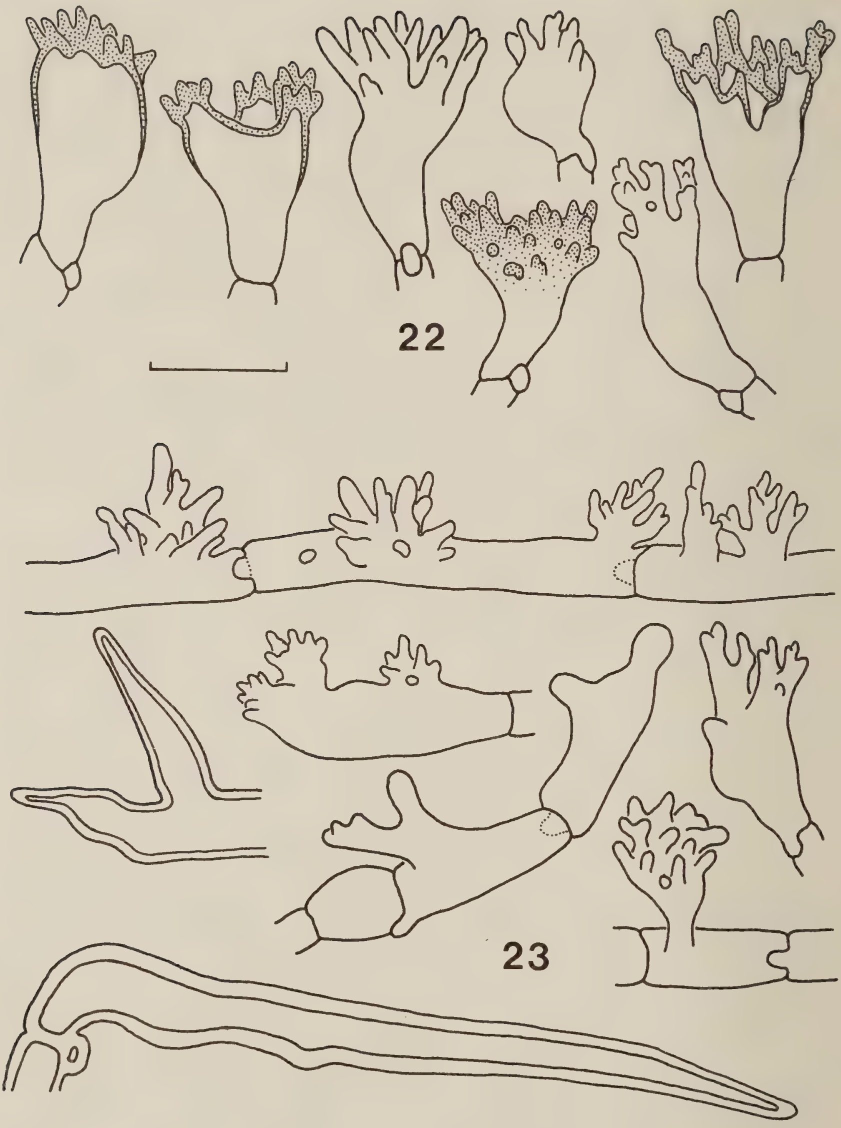
Pileus 1-7(-11) mm latus, e convexo plano-convexus, ruguloso-striatus, subvelutinus; primo bubalinus, griseolo-brunneus, brunneo-aurantius vel brunneus, in aetate pallidior. Lamellae adnatae, confertae vel subdistantes, angustae, pallidae. Stipes 1-2.5 mm longus, <0.2 mm crassus, eccentricus vel centralis, teres, aequalis, falcatus, pruinosus, non insititius, bubalinus. Odor et sapor nullus. Basidiosporae (7.5-)8-10.5(-12) X 3.5-5.2 µm, ellipsoideae vel amygdaliformes, laeves, hyalinae, inamyloideae. Basidia tetraspora. Pleurocystidia rara vel abunda, refractiva, cylindrica, obtusata. Cheilocystidia elementis pileipellis similia. Pileipellis hymeniformis ex elementis *M. sicco* similibus; diverticuli hyalini et ferruginei. Trama ex hyphis dextrinoideis, fibulatis. Caulocystidia diverticulata. In foliis et ramis emortuis dicotyledonum vel monocotyledonum. **Holotypus:** North Carolina, Macon Co., Highlands, Horsecove, 10 Aug. 1987, D. E. Desjardin no. 4415 (no. 47629, TENN).

Basidiomata (Fig. 17) marcescent, reviving. **Pileus** 1-7(-11) mm broad, campanulate or convex, expanding to plano-convex or plane, rarely umbonate, often undulate in age, rugulose-striate; surface dull, dry, opaque, subvelutinous; context thin, whitish; color exceedingly variable, when young buff, greyish cream (4C2), grey (4E2), pale brownish grey (5E2-3), brownish orange (5C4), dark yellowish brown (5F4) or brown (6E4-6), the more deeply pigmented pilei fading in age to light yellowish brown (5D-E4-5), greyish yellow (5D3), pale brownish orange (5C3) or yellowish grey (4B3), but drying darker. **Lamellae** adnate, close or subdistant (7-14 reach the stipe), narrow or moderately broad (-1.5 mm), rarely forked or intervenose near the margin, white, buff or pale yellowish white (4A2) at first, remaining so in age or becoming pale yellowish grey (4B3) or orange white (5A2), not marginate; lamellulae in 1-2 series. **Stipe** 1-2.5 X <0.2 mm, typically eccentric, but often central or rarely nearly lateral, terete, equal, curved or geniculate, pruinose overall, arising from a small, white mycelial pad, white or buff overall when young, remaining so in age or the base darkening to cream (4A3), pale yellowish grey (4B3) or pale brownish orange (5C3). **Odor** and **taste** not distinctive.

Basidiospores (Fig. 18) (7.5-)8-10.5(-12) X 3.5-5.2 µm [$\bar{\bar{x}}$ = 9.4 X 3.9 µm, s = 0.45 X 0.19; E = 1.9-2.9; $\bar{Q}$ = 2.4, s$\bar{Q}$ = 0.12; TL90(90%) = 8.5-10.3 X 3.5-4.3 µm, Q = 2.2-2.7; n = 25/7 specimens], ellipsoid or amygdaliform, often with a slight suprahilar depression and abaxial bulge, with a prominent hilar appendix, hyaline, inamyloid. **Basidia** (Fig. 19) 16-22.5 X 5-6.5(-7.5) µm, clavate, 4-spored. **Basidioles** (Fig. 19) broadly clavate or ventricose-fusoid. **Pleurocystidia** (Fig. 20) rare to numerous, 30-45 X 4.8-8 µm, irregularly cylindric, obtuse, refractive, hyaline, inamyloid, arising from deep in the subhymenium and projecting up to 11 µm beyond basidioles; base often curved. **Cheilocystidia** (Fig. 21) numerous, 11-17(-20) X 4.8-8(-9) µm, diverticulate, similar to pileipellis elements but typically hyaline overall, only rarely with pale ferruginous diverticula; lamellar edge entirely sterile or with scattered basidia, basidioles and rare pleurocystidia-type elements. **Pileipellis** a hymeniform layer of *Siccus*-type elements (Fig. 22), 8.5-16 X 4.5-8.5(-9.5) µm, cylindric, clavate or irregular in outline, often lobed, diverticulate; basal portion of cells hyaline, thin-walled, inamyloid; diverticula 1-7(-9)



Figs. 17-21. Features of **Marasmius falcatipes** [Desjardin 4415, Holotype]. 17. Basidiomata (X3). 18. Basidiospores. 19. Basidia and basidioles. 20. Pleurocystidia. 21. Cheilocystidia. Scale bar = 10 µm.



Figs. 22-23. Features of **Marasmius falcatipes** [Desjardin 4415, Holotype]. 22. Pileipellis elements. 23. Elements of stipe vesture (thick-walled elements from stipe base). Scale bar = 10 µm.

X 0.5-2 µm, irregularly cylindric or contorted, rarely branched, obtuse, hyaline to pale yellowish and thin-walled or ochraceous to ferruginous and thick-walled, pigmented areas weakly dextrinoid. **Pileal** and **lamellar tramal hyphae** interwoven, 2.5-8(-10) µm diam, inflated, non-gelatinous, hyaline, thin-walled, dextrinoid. **Stipe cortical** and **medullary hyphae** similar, parallel, 2.5-10 µm diam, hyaline or pale yellowish, strongly dextrinoid, walls -2 µm thick; hyphae from stipe base strongly sclerified. **Stipe vesture** (Fig. 23) of numerous diverticulate inflations projecting from the outermost layer of cortical hyphae, and with scattered elements similar to those of the pileipellis. **Clamp connections** common throughout basidiomata.

HABIT, HABITAT AND DISTRIBUTION. Scattered to gregarious on senescent leaves or stems of various hardwoods, herbaceous vines or grasses in mixed deciduous woodlands. July - Sept. Uncommon. NC, SC, TN, VA.

MATERIAL EXAMINED. UNITED STATES. NORTH CAROLINA: Buncombe Co.: Lake Powatah, near Asheville, 5.ix.87, DED no. 4472 (no. 47635, TENN). Haywood Co.: GSMNP, Cataloochee, 6.ix.87, DED no. 4485 (no. 47636, TENN); GSMNP, Cataloochee, 9.ix.87, DED no. 4490 (no. 47637, TENN). Macon Co.: Coweeta Hydrologic Lab, Ball Creek, 4.ix.86, DED no. 4134 (no. 47631, TENN); Coweeta Hydrologic Lab, Ball Creek, 13.viii.87, DED no. 4456 (no. 47634, TENN); Highlands, Horsecove, 30.vii.87, DED no. 4413 (no. 47632, TENN); Highlands, Horsecove, 10.viii.87, DED no. 4415 (no. 47629, TENN - **Holotype**). SOUTH CAROLINA: Oconee Co.: Ellicott Wilderness Area, Chattooga Picnic area, 12.viii.87, DED no. 4448 (no. 47633, TENN). TENNESSEE: Blount Co.: GSMNP, Cades Cove, 17.ix.85, DED no. 3485 (no. 47630, TENN). VIRGINIA: no data, R. Vilgalys, US 900746 (BPI). Giles Co.: Jefferson Nat. Forest, 2.x.83, O. K. Miller 20804 (VPI). Montgomery Co.: Blacksburg, VPI, 14.ix.83, R. Vilgalys 83/195, US 900773 (BPI). Washington Co.: Little Tumbling Creek, 17.ix.83, R. Vilgalys 83/202, US 900121 (BPI).

OBSERVATIONS. *Marasmius falcatipes* exhibits substantial morphological and substrate variability. The stipe-pileus insertion ranges from central to nearly lateral, with the full range of variation exhibited within or between collections. Pileus coloration varies from buff, greyish yellow or brownish yellow to brownish orange, brown or grey. Basidiomata have been found growing on senescent leaves or stems of various deciduous hardwoods or herbaceous vines (*e.g.*, *Rubus*, *Lonicera*), as well as grass leaves. Moreover, there appears to be no correlation between degree of stipe eccentricity, pileus coloration and substrate preference.

Marasmius falcatipes belongs in sect. *Sicci*, subsect. *Siccini* Singer (1965) because of *Siccus*-type pileipellis elements, non-collariate lamellae, non-insititious stipe and dextrinoid tramal hyphae. Singer (1976) established two series within subsect. *Siccini* based on the presence of well-differentiated pleurocystidia (ser. *Haematocephali*) or their absence (ser. *Leonini*). Although *M. falcatipes* possesses distinctive pleurocystidia, it appears to be most phenetically similar to several taxa belonging to ser. *Leonini*, *viz.*, *M. armeniacus* Gilliam (1975a) and *M. pusio* Berk. & Curt. (1853). *Marasmius armeniacus* [**Holotype**: Gilliam 932a (MICH!)] and *M. pusio* var. *pusio* [**Isotype**: Ravenel 816 (FH!)] both differ from *M. falcatipes* in longer stipes (at least two times longer than the width of the pileus) and having more polymorphic caulocystidia. In comparison, the stipe of *M. falcatipes* is usually shorter than the width of the pileus. *Marasmius pusio* var. *guatopoensis* (Dennis) Sing. essentially differs only in lacking pleurocystidia (*fide* Dennis, 1961).

If greater taxonomic emphasis is placed on the presence of a short, eccentric stipe, it could be argued that *M. falcatipes* belongs in sect. *Neosessiles* Singer (1958). This section was established to unify all taxa combining the following characters: 1) pleurotoid habit (*i.e.*, stipe eccentric, lateral or absent); 2) non-collariate lamellae; 3) dextrinoid tramal tissue; and 4) hymeniform pileipellis of diverticulate elements. Subsequently, Singer (1965) emended the section to include both dextrinoid ("pseudoamyloid") tramal hyphae (subsect. *Neosessilini*) and inamyloid tramal hyphae (subsect. *Spaniophyllini*). If taxa currently placed in sect. *Neosessiles* are re-evaluated utilizing characters in common usage at sectional or subsectional levels, it appears that sect. *Neosessiles* is somewhat heterogeneous. It contains taxa with *Siccus*- or *Rotalis*-type pileipellis elements, insititious or non-insititious stipes, dextrinoid or inamyloid tramal tissue, and with or without pleurocystidia [see Singer (1976) for a thorough treatment of the neotropical species]. Examination of the holotype specimens of a number of species currently placed in sect. *Neosessiles* (Desjardin, unpublished data) indicates that this section includes discordant elements. For example, *M. polycystis* Singer (1976) exhibits all characters diagnostic of sect. *Sicci* except for the presence of a short, eccentric stipe. Indeed, when compared with *M. falcatipes, M. polycystis* differs only in pleurocystidial morphology. In the latter, pleurocystidia are broadly ventricose and average 13.6 µm in width [n = 45 cystidia. Known only from the **holotype:** Singer B1499 (F!)], while in *M. falcatipes*, pleurocystidia are cylindrical with a mean width of 5.8 µm [TL90(90%) = 4.9-6.7 µm, n = 20/10 specimens). The extensive variability in stipe-pileus insertion exhibited by *M. falcatipes* indicates that stipe eccentricity may be of limited taxonomic value. These data suggest that *M. polycystis* is better placed in sect. *Sicci*, presumably closely allied with *M. falcatipes*. Since many species in sect. *Neosessiles* are known only from their type specimens, which in some cases consist of a single basidioma, it would be premature to dismantle or redefine the section until further material is available for comparative studies.

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This contribution is dedicated to Dr. Harry D. Thiers, whose profound knowledge of the fungi, consummate teaching ability and infinite patience inspired the senior author toward the study of mycology. We thank the following for accompanying us during field studies and for contributing personal specimens to our research: Drs. Heidi and Timm Anke, Timothy Baroni, Andreas Bresinsky, Roy Halling, Egon Horak, Andrew Methven, Harry Thiers and Zang Mu. We thank Drs. David Frodin (PH), John Haines (NYS), Roy Halling (NY), James Kimbrough (FLAS), Gregory Mueller (F), Donald Pfister (FH), Amy Rossman (BPI) and Robert Shaffer (MICH) for facilitating loan of specimens. We are also most grateful to Mrs. Ellen Thiers for checking Latin diagnoses. This research was funded in part by grants-in-aid to the senior author from the Highlands Biological Station, Highlands, NC, and by National Science Foundation Doctoral Dissertation Improvement Grant BSR- 8612110.

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A SYNOPSIS OF COLOMBIAN BOLETES

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RESUMEN

En el presente quince especies de Boletaceae son conocidas en el norte de los Andes en Colombia; ellos pertenecen a *Austroboletus, Boletellus, Boletus, Gyrodon, Leccinum, Strobilomyces*, y *Tylopilus*. Associaciones ectomycorrizicas con *Quercus humboldtii* y *Alnus acuminata* son asumidas en la mayoria de los casos. Por primera vez en la taxa se describen **Boletus orquidianus, Leccinum andinum,** y **Tylopilus obscurus.**

INTRODUCTION

Several weeks collecting during October-November 1986 and May 1987 in the Andean regions of Antioquia, Boyacá, Cauca, Cundinamarca, and Huila of Colombia resulted in the discovery of a number of interesting taxa (*e.g.,* Halling & Ovrebo, 1987a,b). In particular, repeated trips to forests of *Quercus humboldtii* Bonpl. showed that members of the Boletaceae were fairly well represented. Also, in one area near Popayán, *Alnus acuminata* H.B.K. was found to support *Gyrodon monticola* Sing., originally described from Argentina (Singer & Digilio, 1958).

Recent reports on Boletaceae from South America include works by Horak (1977), Ovrebo (1983), Singer (1964, 1970, 1973), Singer & Digilio (1951, 1958, 1960), Singer et al. (1983), and Wolfe et al. (1988). Generally, these papers discuss boletes found in temperate/subantarctic *Nothofagus* forests, Amazonia, or other lowland tropical/subtropical regions of South America. Except for the report of *Boletellus ananas* (Curt.) Murr. and *Boletus fuligineotomentosus* Sing. from oak forests near Cali, Colombia (Singer, 1970, 1973), other Boletaceae (excluding *Phylloporus*) from that country have not been treated. Even though some taxa mentioned below also occur in the north temperate zone (North America, Europe, or Japan), I suspect these boletes are also native in Colombia [unlike *Suillus luteus* (Fr.) S.F. Gray and *Boletus piperatus* Fr. which are found associated with exotic *Pinus* spp.]. As mentioned previously (Singer, 1963, 1964; Singer & Morello, 1960), the oak forest mycota of Colombia remains essentially unsurveyed, thus this treatment of Colombian boletes must be considered a preliminary one.

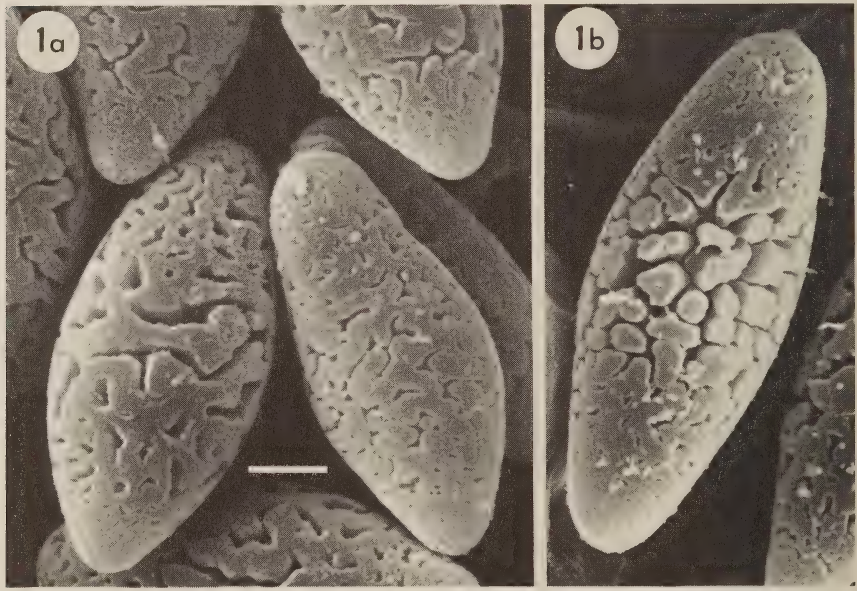
Descriptions of Colombian boletes are given for those taxa that are newly described or of questionable identity, poorly known or thought to be true South American endemics. For species of *Gyrodon*, extralimital South American material has been compared. Color notations given as page, column, row (*e.g.*, 6C6) are from Kornerup & Wanscher (1978). Other color names are general approximations.

1. AUSTROBOLETUS SUBVIRENS (Hongo) C. B. Wolfe, Bibl. Mycol. 69: 125. 1979. FIG. 1

≡ *Porphyrellus subvirens* Hongo, Acta Phytotax. Geobot. 18: 110. 1960.

Pileus 1.5 cm broad, convex, dry, with dull-green, granulose to crustose scales, sometimes fasciculated and then forming minute suberect or repent areolae. *Flesh* white, without *odor* or *taste*. *Tubes* porphyry pinkish, not changing when bruised. *Stipe* 3 cm long, 3-4 mm thick, ±equal, dry, white, green-subreticulate above, irregularly scaly below; scales sometimes coalescing and appearing alveolate-ridged (under a lens); interior white, unchanging.

Basidiospores smooth at first, with wall becoming minutely pitted, eventually dissected by meandering subreticulate channels that occasionally isolate irregular truncate warts or ridges, especially around middle, with walls up to 1.4 μm thick, 14.7-18.2 × 6.3-8.8 μm (mean Q=2.17), broadly subfusoid to elongate-amygdaliform, with a suprahilar depression, yellow brown in KOH, unreactive or dextrinoid in Melzer's. *Basidia* broadly clavate to subsaccate, hyaline, (3)4-sterigmate, 24-35 × 12-15 μm. *Hymenial cystidia* absent. *Tube trama* divergent from a central stratum, with gelatinized lateral stratum; hyphae hyaline, 3.5-6.3 μm broad. *Pileus surface* a trichodermium of long, cylindrical elements, sometimes fascicled, 5-10 μm broad, smooth- and thin-walled, with dark green vacuolar pigment,



FIGS. 1 a,b. Scanning electron micrographs, basidiospores of *Austroboletus subvirens* (*Halling 5955*). Standard line = 2 μm.

dissolving in KOH, irregularly coagulated in Melzer's and water mounts. *Stipe surface* lacking caulocystidia, with hyaline, narrow, subgelatinized hyphae, overlain with cylindrical elements forming reticulum, the latter morphologically similar to trichodermial elements of pileus. *Clamp connections* absent.

Material examined: DEPT. HUILA: near Parque Nacional Puracé, Finca de Ganadería Merenberg, under *Quercus humboldtii*, 21 May 1987, *Halling 5955* (NY).

The identity of this collection is tentative because only one, diminutive basidiocarp was found, and *A. subvirens* has been reported previously only from Japan and New Guinea. Despite the small size, other important characters such as the overall appearance of surface features, coloration, spore morphology and other microscopic features, correspond quite well to the protologue (Hongo, 1960), a later evaluation of the type specimen (Wolfe, 1979), and illustrations and comments on additional fresh material (Horak, 1980). However, more collections from Colombia are needed to assess the range of typical variation.

2. BOLETELLUS ANANAS (Curt.) Murr., Mycologia 1: 10. 1909.
≡ *Boletus ananas* Curt., Amer. J. Sci. II 6: 251. 1848.

I have not seen specimens from Colombia, but information and a description of Colombian material can be found in Singer (1970) where one collection is cited: "VALLE. Rio Pance, 1800 m alt, 3 May 1968, *Singer B6942* (F)." Also known to occur north to the southeastern United States and in southeast Asia.

3. BOLETELLUS RUSSELLII (Frost) Gilbert, Bolets. 107. 1931.
≡ *Boletus russellii* Frost, Bull. Buffalo. Soc. Nat. Sci. 2: 104. 1874.

Only one immature basidiocarp was found in a 30 year-old, second-growth oak forest near Popayán. Despite the lack of spores, the long, coarsely lacerate-reticulate dull-reddish stipe with a viscid white base is an unmistakable field character. Detailed descriptions of material from the United States are available in Singer (1945) and Smith & Thiers (1970).

Material examined: DEPT. CAUCA: Municipio de Tunía, km 93 of Cali-Popayán road, Reserva Forestal "El Guayabo," 1800 m, under *Quercus humboldtii*, 19 May 1987, *Halling 5270* (leg. G. Mueller) (NY).

4. BOLETUS ATKINSONIANUS (Murr.) Sacc. & Trott., Syll. Fung. 21: 236. 1912. FIGS. 2-5

≡ *Ceriomyces atkinsonianus* Murr., N. Amer. Flora 9: 144. 1910. TYPE: United States. NORTH CAROLINA: Pink Bed Valley, Jul 1908, *Murrill & House 64* (Holotype: NY!).

Pileus 2.5-8.5 cm broad, convex to plano-convex, viscid when wet, matted tomentose or areolate when dry; surface brown (7E8) to reddish brown (9E8) on disc and brownish orange (6C5) at margin when young, brownish orange (7C5) to light brown (7D5) to dull reddish (8C4-8C5) with age, uneven to shallowly pitted-rugulose or wrinkled in some; margin sterile and projecting about 1-1.5 mm when young, not so much with age; *flesh* 4-11 mm thick, white, unchanging, slightly reddish brown under pileus surface. *Odor* and *taste* mild. *Tubes* 5-17 mm long, unchanging when exposed, lemon yellow (2A8) to light yellow (3A5) when young,

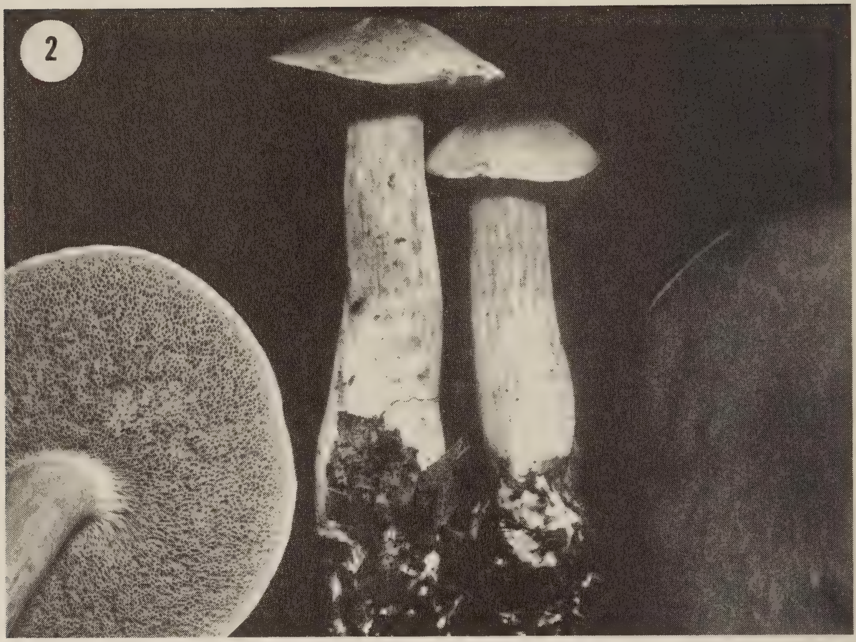
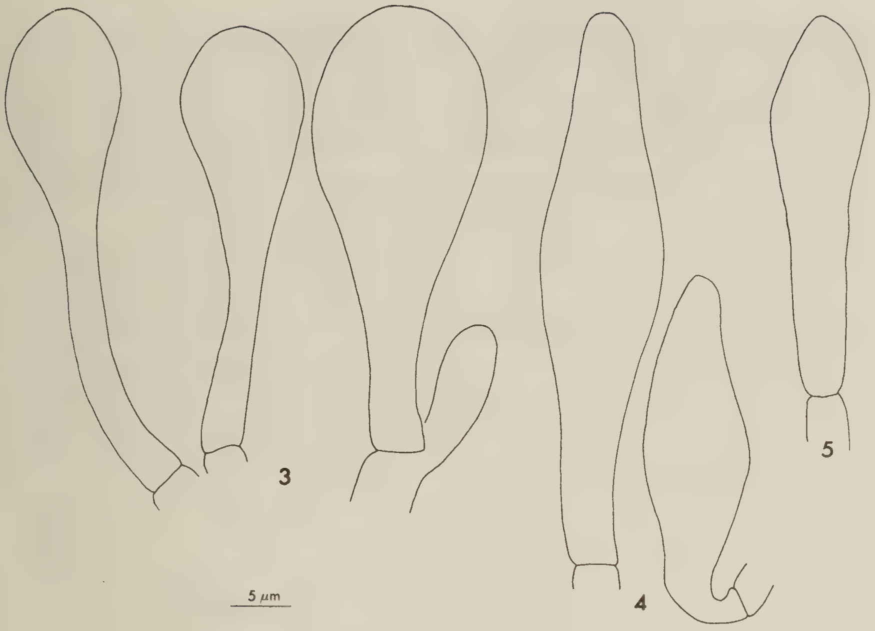


FIG. 2. Habit of *Boletus atkinsonianus*. (*Halling 5000*) ×1/2.

more greenish yellow (3D7-3E7) with age; *pores* up to 1 per mm, light yellow (3A5) when young, mustard yellow to wax yellow (3B6-3B5) with age, unchanging when bruised. *Stipe* 7.5-12 cm long, 8-11 mm thick at apex, subclavate to broader below or sometimes ±equal, strict to somewhat curved, solid; surface subviscid to tacky when wet, glabrous, lacking reticulations, but some broad and obscure rugulose zones present or coarse alveolate ridges at apex when very young, streaked with reddish brown (8D6), with some yellowish to grayish orange (6B5) ridges near apex to half the length on white ground color, reddish brown (8D6) more abundant at apex when young, becoming whitish there with age, reddish brown (8D6) more abundant below with age, but with a white base throughout development; *interior* white, solid, unchanging.

Basidiospores olivaceous in fresh deposit, yellowish brown in KOH, occasionally some dextrinoid in Melzer's, smooth, thin-walled, subfusoid and inequilateral in profile to oblong ellipsoid, 11.9-16.8 × 4.9-6.3 μm (mean Q=2.7). *Hymenophore* lemon yellow in water mounts, this color disappearing in KOH mounts, often with dextrinoid encrusting pigment in Melzer's when young. *Basidia* 24-32 × 8-11 μm, clavate, 4-sterigmate, hyaline. *Pleurocystidia* hyaline in KOH, hyaline or rarely pale orangish in Melzer's, fusoid, thin-walled, 35-53 × 8-15 μm. *Cheilocystidia* barely subfusoid to subclavate, hyaline in KOH, pale orangish in Melzer's, not as abundant as pleurocystidia, 30-40 μm long. *Tube trama* divergent from a central stratum, with gelatinized lateral strata, hyaline, 3.5-7 μm broad. *Pileus trama*



FIGS. 3-5. Cystidia of *Boletus atkinsonianus* (*Halling 5026*). 3. Caulocystidia. 4. Pleurocystidia. 5. Cheilocystidium.

hyaline in KOH and Melzer's, interwoven, with hyphae 5-9 µm broad. *Pileus surface* a tangled trichodermium in a gelatinous matrix, with elements subcylindrical, rarely inflated, often vermiform in general aspect, smooth, with vacuolar pigment, usually dissolving in KOH or yellow brown, coagulated and orangish in Melzer's, (2.8)3.5-8.4(10.5) µm broad. *Stipe surface* composed of vertically oriented, parallel hyphae, becoming gelatinized with age, hyaline in KOH, encrusted with dextrinoid pigment and penicillate crystals in Melzer's, giving rise to *caulocystidia*, the latter often clustered, hyaline and smooth in KOH, sometimes with encrusting dextrinoid pigment, thin-walled, clavate to capitate clavate, generally gelatinizing with age, 24-50 × 7-14(18) µm. *Clamp connections* absent.

Material examined: DEPT. ANTIOQUIA: Municipio Santa Rosa de Osos, near Llanos de Cuivá, 6°45'N, 75°30'W, ±2500 m, under *Quercus humboldtii*, 10 Nov 1986, *Halling 5000* (HUA, NY); 14 Nov 1986, *Halling 5026* (HUA, NY); 25 Nov 1986, *Halling 5057* (HUA, NY); road between San José de la Montaña and Llanos de Cuivá, 6°50'N, 75°35'W, ±2500 m, under *Quercus humboldtii*, 27 Nov 1986, *Halling 5077* (HUA, NY).

Boletus atkinsonianus was originally described from North Carolina, USA, apparently based on Atkinson's (1901) concept of *B. obsonium* (Paul.) Fr., but seems not to have been described in detail since the description by Coker & Beers (1943). Diagnostic features include a viscid pileus and stipe with distinctive brown colors, projecting pileus margin, bright yellow hymenophore when young that, along with the flesh, is unchanging. Perhaps because of age and preservation, the dextrinoid pigment in the stipe and young hymenophore of the type specimen is absent, but would seem to be a further distinction in fresher material. Most likely, *B. atkinsonianus* might be confused with *B. viridiflavus* Coker & Beers, but the latter is a smaller fungus with the pileus mottled a greenish yellow (*Halling 3788*, NY). A color illustration of *B. viridiflavus* (Weber & Smith, 1985) from the southeastern United States is reminiscent of the Colombian *B. atkinsonianus*. Guzmán-Dávalos et al. (1983) have reported the latter from Jalisco, México.

5. BOLETUS FULIGINEOTOMENTOSUS Singer, Beih. Sydowia 7: 101. 1973.

I have not seen specimens from Colombia, although I have collected near the paratype locality. Known only from Colombia, information and a description of *B. fuligineotomentosus* can be found in Singer (1973) where three collections are cited: "Typus a R. Singer (B 6958) in Columbia: Valle: Rio Pance, 1800 m alt., 3 V 1968 lectus et in F conservatus.-Paratypus: Singer B 6466, Cauca: via a Cali Popayán versus, km 100, 29 IV 1968.-Etiam B 6790, El Guayabo 29 IV 1968, omnes in F.-*Boleto subsolitario* affinis."

6. **BOLETUS ORQUIDIANUS** *sp. nov.* FIGS. 6-9

Pileus viscidus, pileipelle hymeniformi; trama tuborum phylloporoideo; cystidia hymenii nulla; basidiosporae 10.5-13.3 × 4.2-5.6 µm, laeves, interdum dextrinoideae.

Pileus 2-2.5 cm broad, convex to plano-convex, reddish brown to brown (7F8-8E8), paler at the margin, moist to viscid, glabrous, not changing with NH_4OH. *Flesh* white, not bluing, with mild *odor* and *taste*. *Tubes* depressed around the

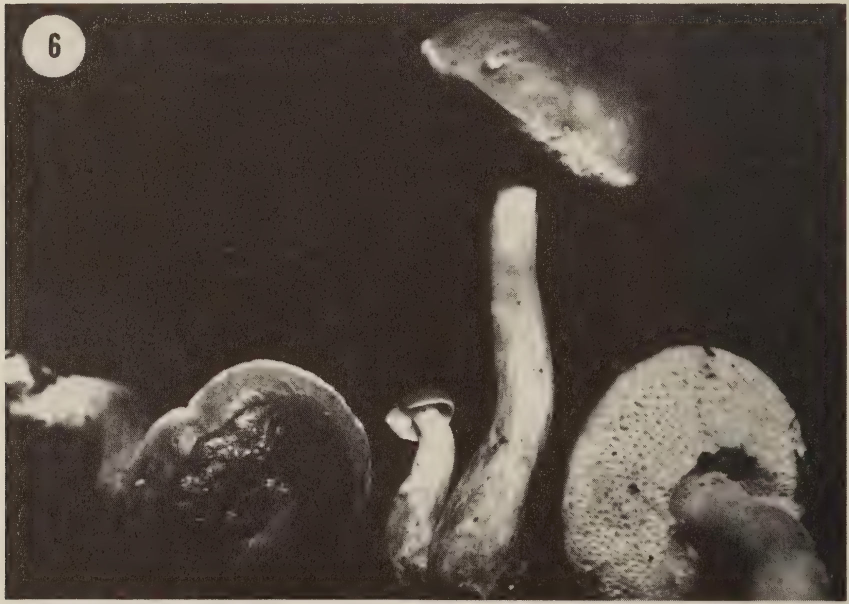


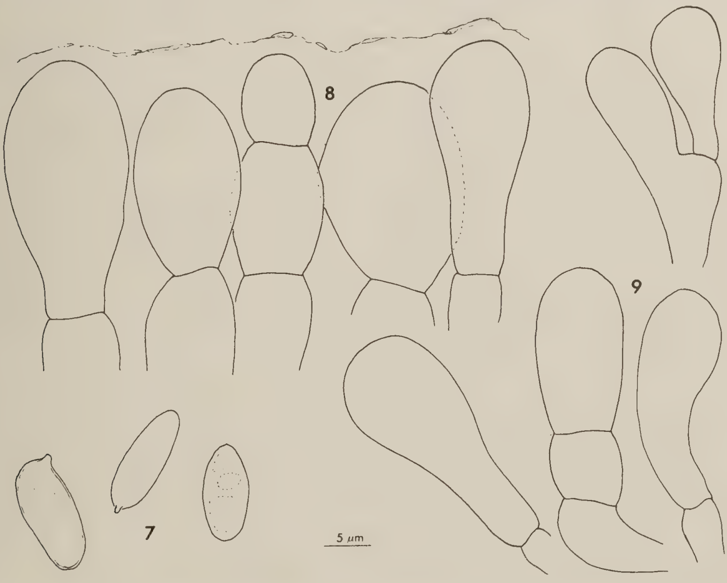
FIG. 6. Habit of *Boletus orquidianus* (*Halling 4964*, HOLOTYPE). ×2.

stipe, olive yellow to grayish yellow (3C6-3C5) not changing to blue when exposed, 5-7 mm long; *pores* up to 1 mm broad, concolorous, not changing to blue when bruised. *Stipe* 4-8 cm long, 4-5 mm broad at apex, ± equal to slightly larger at base; surface white at apex and base, streaked brownish (7E7) in mid-region, lubricous but not viscid,glabrous.

Basidiospores smooth, thin-walled, ellipsoid to subfusoid, golden yellow in KOH, a minority slightly dextrinoid in Melzer's, 10.5-13.3 × 4.2-5.6 μm. *Basidia* clavate, 4-sterigmate, hyaline, 28-35 × 12-15 μm. *Hymenial cystidia* absent. *Tube trama* slightly bilateral (*Phylloporus*-type), with hyphae hyaline, 2.8-8.4(14) μm broad. *Pileus surface* a hymeniform epithelium embedded in an obvious gelatinous matrix, with elements hyaline or golden yellow to yellow brown in KOH, hyaline or sometimes with dull orangish contents in Melzer's, broadly clavate to napiform or sphaeropedunculate, sometimes subisodiametric, appearing sphaerocyst-like in paradermal section, smooth and thin-walled, 17.5-31.5 × 14-24.5 μm. *Pileus trama* interwoven, hyaline in KOH, pale orange in Melzer's, with hyphae 4.2-9.8(14) μm broad. *Stipe surface* composed of parallel and vertically oriented hyphae, 2.8-7 μm broad, giving rise to scattered clumps of *caulocystidia* that are clavate to subcylindric, 21-35 × 10.5-14 μm, rarely with an occasional dermatobasidium. *Clamp connections* absent.

TYPE: COLOMBIA. DEPT. ANTIOQUIA: Municipio Urrao, Parque Nacional Natural "Las Orquideas," sector Calles, 1300-1400 m, 30 Oct 1986, *Halling 4964* (HOLOTYPE: HUA; ISOTYPE: NY).

Boletus orquidianus is not associated with Fagaceae in Colombia, but rather with other hardwood trees in the submontane cloud forest. *Boletus orquidianus*



FIGS. 7-9. Microscopic features of *Boletus orquidianus* (*Halling 4964*, HOLOTYPE). 7. Basidiospores. 8. Elements of pileus surface. 9. Caulocystidia.

keys to *Xerocomus globuliger* Sing. in Singer et al. (1983), which differs in a dry (not viscid) and granular to rivulose pileus surface, longer spores (13-17.5 μm), and the presence of hymenial cystidia and pilocystidia. The viscid pileus and *Phylloporus*-type trama would also suggest *Pulveroboletus* (*sensu* Singer), but the hymeniform pileus surface of *B. orquidianus* is like that found in *Marasmius* sect. *Globulares* but with a gelatinous matrix. Furthermore, none of the pileus surface types (cutis, ixocutis, trichodermium, or palisade) described for *Pulveroboletus* by Singer (1986) are applicable to *B. orquidianus*. Additionally, the spores of *B. orquidianus* are 2-5 μm longer than the non-velate Pulveroboleti listed by Singer et al. (1983) and Pegler (1983).

7. BOLETUS PULVERULENTUS Opat., Arch. Naturgesch. 2: 27. 1836.

The dry, dark brown to nearly black pileus, yellow hymenophore and flesh that turn instantly to blue when bruised or exposed are key macroscopic features. Microscopically, the abundant hymenial cystidia with dextrinoid granular content are likewise distinctive. Known previously from the north temperate zone, the single Colombian collection of several basidiocarps agrees in all respects with material from eastern North America.

Material examined: DEPT. CUNDINAMARCA: near Pacho, Finca "La Ramada," under *Quercus humboldtii*, 11 May 1987, *Halling 5251* (NY).

8. BOLETUS PSEUDORUBINELLUS Smith & Thiers, Boletes of Michigan. 300. 1970. FIG. 10

Pileus 2-6.5 cm broad, dry, convex to plano-convex, violet brown (10E5) at first, then english red to reddish brown (8D8-8D6), matted subtomentose to matted subvelutinous, barely with finely appressed squamules near the margin with dull ochraceous color showing through. *Flesh* up to 1.5 cm thick, near pinkish white (7A2) but ±paler with a faint tint of yellow, unchanging; *odor* and *taste* mild. *Tubes* near old rose (10D5) at first, near reddish brown (8D6) with age; pores concolorous, unchanging, ±1 per mm, adnate or depressed around the stipe. *Stipe* 5-7 cm long, 4-12 mm broad, equal or tapering downward, fibrous, curved or strict, fibrillose striate, near brick red (7D7), dry, with pinkish zone at apex, white or with some pale pinkish tones toward the base, with yellowish mycelium extending into substrate; interior yellowish, solid.

Basidiospores smooth, thin-walled, pale olivaceous at first, but then bright greenish yellow in KOH, some becoming lightly dextrinoid in Melzer's, 9.1-12.6 × 4.2-4.9 μm (mean Q=2.28), ellipsoid to subfusoid and inequilateral in profile. *Basidia* 4-sterigmate, clavate, hyaline, 19.6-31.5 × 8.4-10.5 μm. *Hymenial cystidia* rare, narrowly fusoid ventricose, hyaline, 35-47 × 7-11 μm, more abundant on the pores and then sometimes with amorphous pale brown content in KOH. *Pileus surface* a trichodermium of suberect, tangled, cylindrical cells, 5-9 μm broad, soon collapsing and becoming repent; hyphae hyaline to pale ochraceous yellow from pigment dissolving in KOH, but pigment remaining in Melzer's and appearing granular-encrusting. *Pileus tramal* hyphae hyaline in KOH, somewhat collapsed and sometimes with a pale orangish tint in Melzer's, otherwise inamyloid, sometimes with scattered oleiferous elements. *Caulocystidia* often clustered, narrowly fusoid ventricose, clavate, or sometimes spherical-saccate, thin-walled, 17.5-65 × 7-18 μm, without distinctive contents in KOH or Melzer's. *Clamp connections* absent.

Material examined: DEPT. CAUCA: Municipio de Tunía, km 93 of Cali-Popayán road, Reserva Forestal "El Guayabo," 1800 m, under *Quercus humboldtii*, 19 May 1987, *Halling 5267* (NY).

In the original description of Smith & Thiers (1970), *B. pseudorubinellus* was described as occurring near spruce in northern Michigan. Despite the difference in supposed mycorrhizal hosts, *Halling 5267* agrees in overall colors, spore morphology, yellowish reaction in KOH, lack of an acrid taste, and general lack of hymenial cystidia.

9. BOLETUS SUBTOMENTOSUS Fr., Syst. Mycol. 389. 1821.

≡ *Xerocomus subtomentosus* (Fr.) Quél., Fl. Myc. 418. 1888.

The olive to yellow olive (4D6), dry, subtomentose pileus, yellow tubes that change to blue when cut and exposed, compound pores, yellowish stipe with some occasional coarse ribbing at the apex, and yellowish basal mycelium are useful field characters. Also, the pileus surface does not react with NH_4OH (blue to greenish). The descriptions of Smith & Thiers (1971) and Thiers (1975) fit the Colombian material well.

Material examined: DEPT. ANTIOQUIA: Municipio Santa Rosa de Osos, road from San José de la Montaña to Llanos de Cuivá, 6°50'N, 75°35'W, ±2500 m, under *Quercus humboldtii*, 25 Nov 1986, *Halling 5061* (HUA, NY).

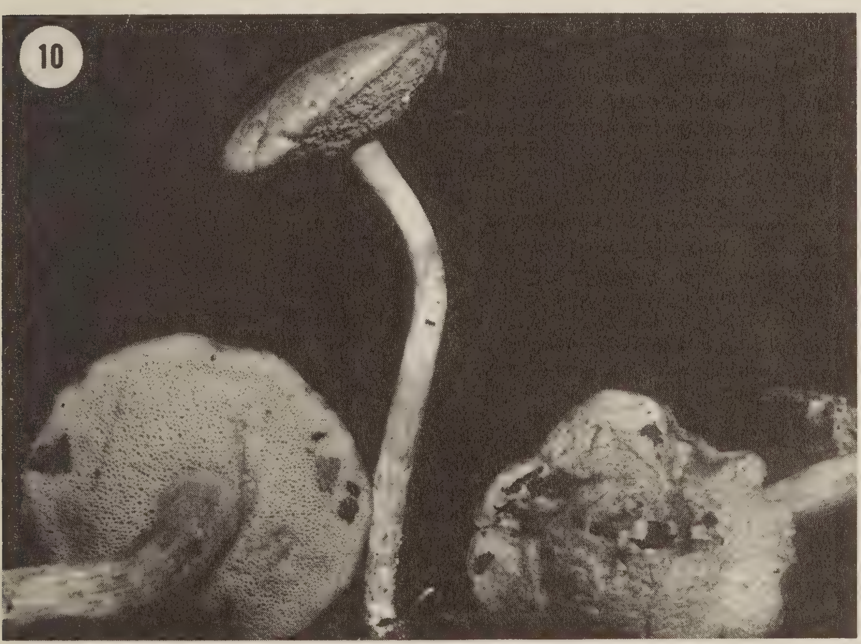


FIG. 10. Habit of *Boletus pseudorubinellus* (*Halling 5267*). ×3/4.

10. BOLETUS TRUNCATUS (Sing., Snell, & Dick) Pouzar, Ceská Mycol. 20: 2. 1966. FIG. 11

≡ *Xerocomus truncatus* Sing., Snell, & Dick *in* Snell, Singer & Dick, Mycologia 51: 573. 1959.

Pileus 1.5-4 cm broad, convex to plano-convex, dry, velutinous to subtomentose, bronze brown (5E5). *Flesh* pale yellow to white (3A3-2A3), not changing to blue when exposed. *Tubes* pastel yellow to grayish yellow (2A4-2B5), compound, 5-9 mm long, with faint hint of changing to blue when exposed; *pores* concolorous. *Stipe* 3-4 cm long, 4-6 mm thick, ±equal, surface furfuraceous to pruinose-squamulose (red to pinkish) on yellow ground color above, pink at middle, pale brown below, eventually with a yellowish white (4A2) ground color.

Basidiospores truncated at the apex and then usually thicker-walled at the two apical angles and with markedly thinner wall between these angles, sometimes with faint but distinct longitudinal striae (with interference optics), yellowish brown in KOH, often fleeting amyloid and then some slowly and partially or completely dextrinoid in Melzer's, 11.2-15.4 × 4.9-5.6 μm (mean Q=2.5). *Basidia* 4-sterigmate, hyaline to pale yellowish in KOH and Melzer's, 24-42 × 9-12 μm. *Hymenial cystidia* not abundant but conspicuously projecting, fusoid to subventricose, hyaline in KOH and Melzer's, 35-68 × 9-12 μm. *Tube trama* of the *Phylloporus*-type, obscurely bilateral, hyaline in KOH and Melzer's, with hyphae 3.5-8.4 μm broad. *Pileus surface* a palisade trichodermium, with elements ochraceous in KOH, brown in Melzer's, generally encrusted, with individual hyphae barrel-shaped to isodiametric or nearly so, with apical cells subspherical to subcylindric, obtuse at the tips, (7)17-28 μm broad. *Pileus trama* hyaline, interwoven, with hyphae 7-17 μm broad. *Stipe surface* composed of vertically oriented hyphae giving rise to isolated fascicles of *caulocystidia*, the latter subclavate to clavate or rarely subcapitate, with yellow brown contents or rarely hyaline, in KOH, 24-42 × 7-11 μm, with occasional 2,4-sterigmate *caulobasidia* intermixed. *Clamp connections* absent.

Material examined: DEPT. ANTIOQUIA: Municipio Santa Rosa de Osos, road from San José de la Montaña to Llanos de Cuivá, 6° 50'N, 75°35'W, ±2500 m, under *Quercus humboldtii*, 25 Nov 1986, *Halling 5059* (HUA, NY).

This is a tentative determination although the macroscopic features (very similar to *B. chrysenteron* Fr.) and truncate spores point toward *B. truncatus*. The presence of longitudinal striae are foreign to the protologue, current concepts and descriptions, but there appear to be other xerocomoid taxa in the United States which possess striate spores that may or may not be truncate.

11. GYRODON EXIGUUS Singer & Digilio, Lilloa 30: 154. 1960. FIG. 12

Pileus 1-3 cm, flabelliform to fan-shaped to infundibuliform, dry, matted fibrillose scaly, especially at margin, with brown, appressed fibrillose scales on yellowish (4A5-4B5-5B5) ground color. *Flesh* yellow, up to 2 mm thick, slowly bluing, with mild *odor* and *taste*. *Hymenophore* decurrent, boletinoid, with compound pores, definitely radial in orientation, yellowish (4A6), bluing at first when bruised or cut, then changing to brown. *Stipe* lateral or sometimes eccentric, up to 1.5 cm long, 8 mm thick at apex, yellow to pale orange (5A3) above, olive brown to watery brownish toward base, matted tomentose with a lens, arising from a dirty yellow-

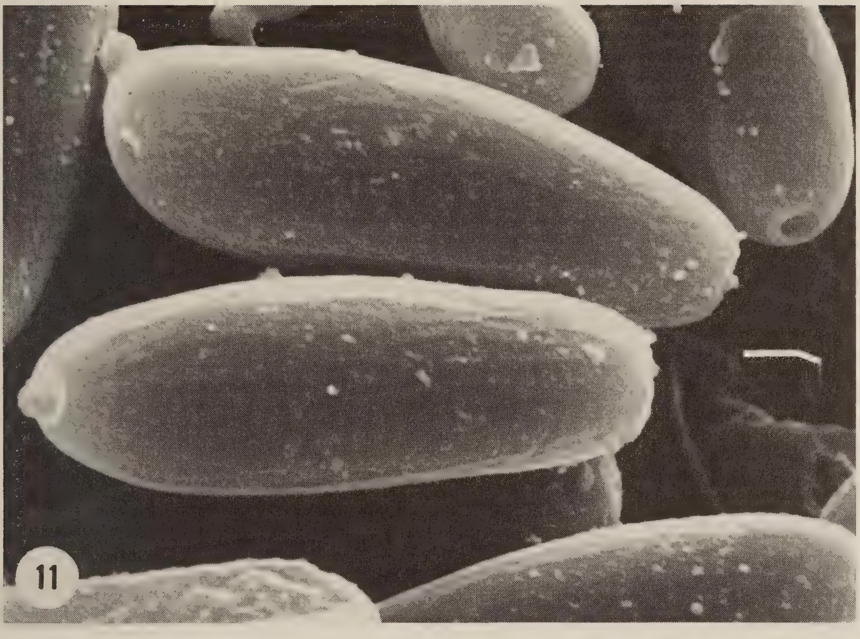


FIG. 11. Scanning electron micrograph, basidiospores of *Boletus truncatus* (*Halling 5059*). Standard line = 1.4 μm.

brown superficial mycelium, the latter sometimes forming rhizomorphic strands over the substrate.

Basidiospores olive brown in deposit, 7-9.8 × 4.9-6.3 μm, (mean Q=1.55), hyaline to pale yellow brown in KOH, fleeting amyloid at first, but then some dextrinoid or pale yellowish brown in Melzer's, smooth, ovoid to broadly ellipsoid, rarely short-subcylindric. *Basidia* clavate, 4-sterigmate, hyaline, 22-30 × 6.5-9 μm. *Hymenial cystidia* rare to scattered and inconspicuous, hyaline, subclavate with a broad mucro, or subcylindric, sometimes with short apical ramifications, 15-25 × 4-9 μm. *Tube trama* hyaline, bilateral, with hyphae 2.1-8.4 μm broad. *Pileus surface* a tangled trichodermium with elements that form the fibrils possessing a red brown encrusting pigment in Melzer's, the pigment soluble in KOH, sometimes with homogeneous ochraceous contents, thin-walled, ±cylindric to filamentous, 3.5-8 μm broad. *Pileus trama* hyaline in KOH, hyaline to pale orange in Melzer's, with hyphae interwoven, thin-walled, smooth, 3.5-10.5 μm broad. *Stipe surface* a collapsed trichodermium with hyphae resembling those of the pileus surface, arising from a hyaline *trama* with elements 4-15 μm broad. *Clamp connections* present.

Material examined: COLOMBIA. DEPT. ANTIOQUIA: Municipio Urrao, Parque Nacional Natural "Las Orquideas," sector Calles, 1300-1400 m, 28 Oct 1986, *Halling 4942*; 30 Oct 1986, *Halling 4969* (both HUA, NY). ECUADOR. PROV. PASTAZA: 2 km N of Rio Pastaza-Rio Topo confluence, 15 April 1987, *Halling 5168* (QCA, NY).

The dingy yellowish pileus with brown appressed fibrils, yellow hymenophore and flesh that become blue with handling and exposure, eccentric to lateral stipe, and small size (for a bolete) are diagnostic macroscopic features. In my experience, *G. exiguus* fruits on standing tree trunks or wet soil banks that are covered with rootlets, humus, etc. rather than on the forest floor. A mycorrhizal connection has not been demonstrated for *G. exiguus* as it has for the following species.

12. GYRODON MONTICOLA Sing. *in* Singer & Digilio, Lilloa 28: 256. 1957.

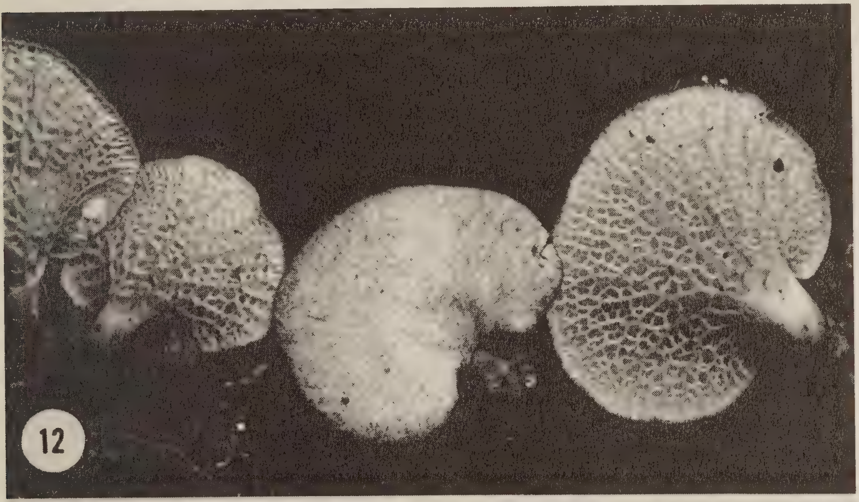
FIG. 13

Pileus 3-11 cm broad, viscid in wet weather, otherwise dry, dark cinnamon brown, matted fibrillose, convex or rarely a with subacute low umbo, with incurved margin at first. *Flesh* whitish, bluing when exposed, up to 2 cm thick. *Hymenophore* boletinoid, decurrent, with compound pores, shallow, up to 2 mm long, yellow, bluing when bruised. *Stipe* 2-6 cm long, 5-14 mm thick, ± equal to subclavate or narrower downward, central to eccentric, curved or strict; surface dry, pinkish brown, more sordid toward the base, especially after handling, matted subtomentose to matted subfibrillose, arising from well-developed, dirty yellowish brown basal mycelium, developing scattered concolorous sclerotia, the latter hard but brittle, dull when fresh, wrinkled and shiny when dry, 1-2(3) mm broad, globose to subglobose.

Basidiospores olive brown in deposit, 5.6-7 × 3.5-4.9 μm (mean Q = 1.46), smooth, hyaline to pale yellow brown in KOH, some lightly dextrinoid in Melzer's, ovoid to short ellipsoid, sometimes inequilateral in profile. *Basidia* 31-42 × 7.5-9 μm, 4-sterigmate, clavate, hyaline or rarely with pale yellow brown pigment. *Tube trama* hyphae bilateral, hyaline, 3.5-9(13) μm broad. *Hymenial cystidia* most abundant at and near pores, generally hyaline, sometimes with amorphous yellow brown content, thin-walled, narrowly fusoid-ventricose with ampullaceous apex, 30-60 × 7.5-9 μm. *Pileus surface* a trichodermium of loosely interwoven hyphae, with elements generally cylindrical, but sometimes irregularly inflated or strangulated, occasionally branched, thin-walled, smooth and hyaline to ochraceous in KOH, pale orange brown and with red brown encrusting pigment in Melzer's, (2.1)3.5-7(9) μm broad. *Pileus trama* hyaline, with pale rosy purplish pigment leaching out in KOH mounts, hyaline to pale yellowish orange in Melzer's; hyphae 4-8 μm broad, smooth and thin-walled. *Stipe surface* barely differentiated from tramal hyphae, loosely interwoven, generally repent, hyaline or rarely with ochraceous content, smooth in KOH and Melzer's, 3.5-7 μm broad, subtended by *tramal hyphae* often inflated to 21 μm, leaching a pale rosy purplish pigment in KOH, with walls usually thickened to 1 μm. *Clamp connections* present.

Material examined: ARGENTINA. PROV. TUCUMÁN: Dept. Tafi del Valle, ±5 km N of Tafi del Valle, under *Alnus acuminata*, 18 Mar 1988, *Halling 5849* (NY). COLOMBIA. DEPT. HUILA: E of Parque Nacional Puracé, Finca de Ganadería Merenberg, under *Alnus acuminata*, 21 May 1987, *Halling 5287* (NY).

Gyrodon monticola appears to be exclusively associated with *Alnus acuminata* in South America. In fact, *Halling 5287* was found in nursery beds consisting solely of *A. acuminata* at Finca Merenberg. The Colombian material corresponds well with a collection (*Halling 5849*) from near the Argentine type locality. *Gyrodon* *monticola* was also found by G. Mueller in *Alnus* forests of Ecuador (Napo Province, ±8-9 km east of Papallacta, along road to Baeza), but voucher material was not retained because of its advanced age. The sclerotia of *G. monticola* are nearly the same morphologically as those reported for *G. merulioides* (Schw.) Sing. (as *Boletinellus*) by Cotter & Miller (1985) but seem to differ in color.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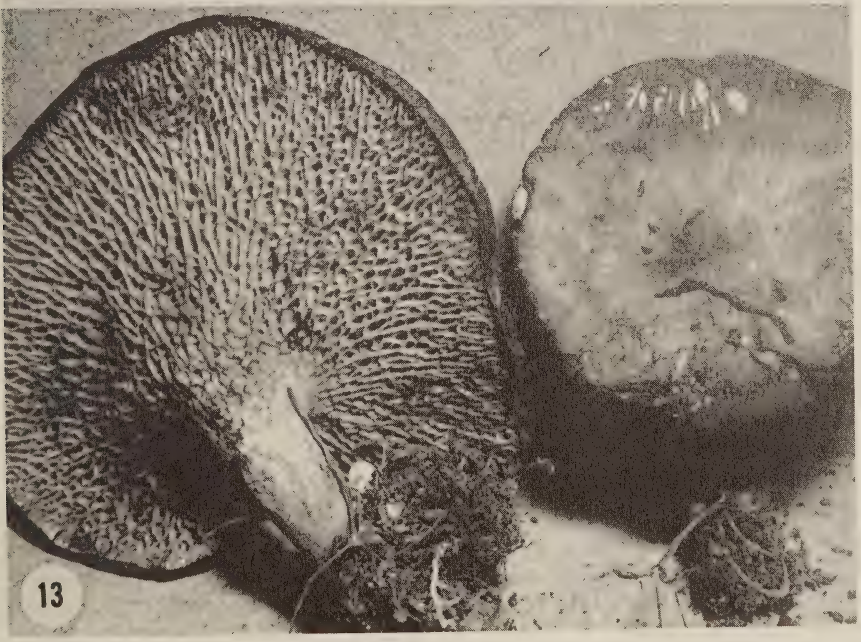
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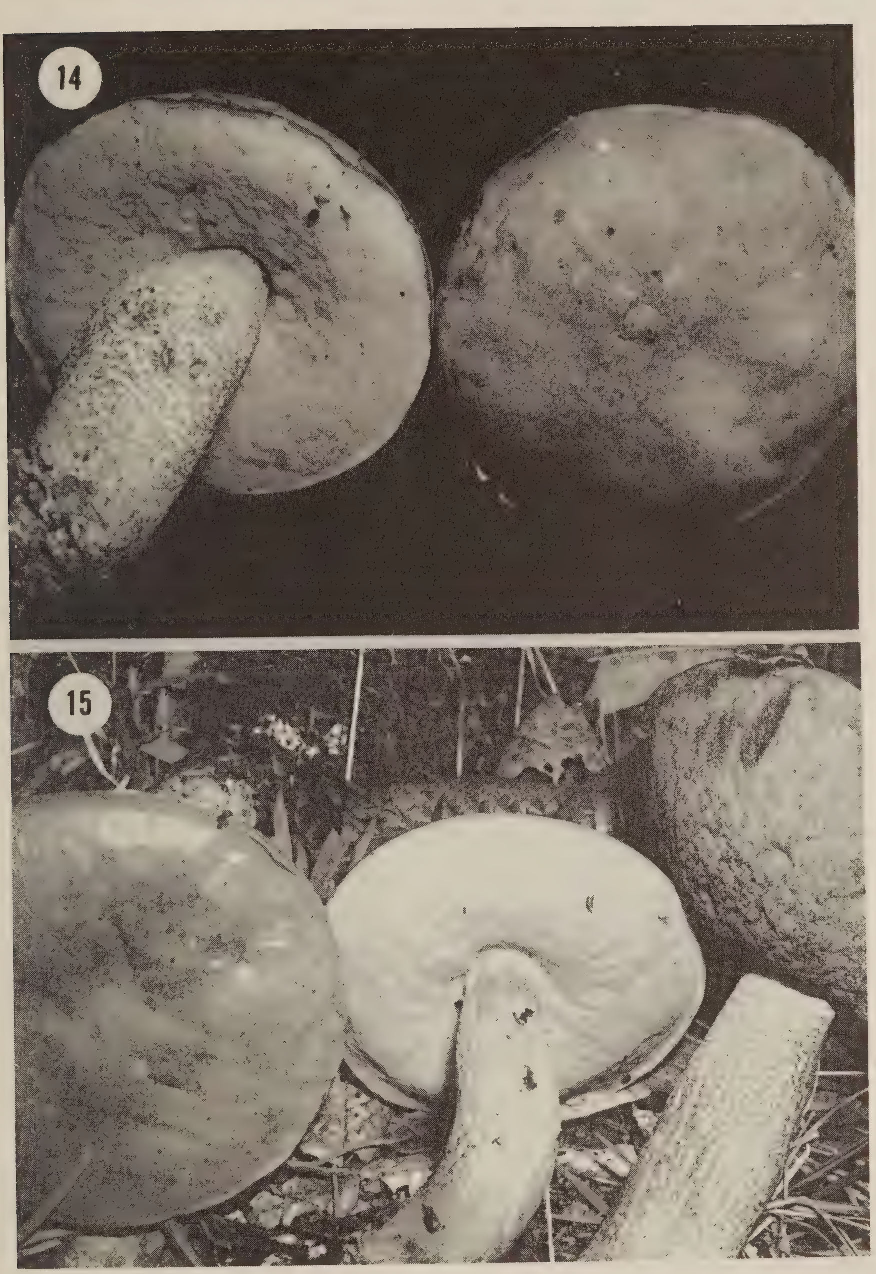
FIGS. 12-13. Habits of *Gyrodon exiguus* and *G. monticola*. 12. *G. exiguus* (*Halling 4969*) ×2. 13. *G. monticola* (*Halling 5849*) ×1.

13. **LECCINUM ANDINUM** *sp. nov.* FIGS. 14-18

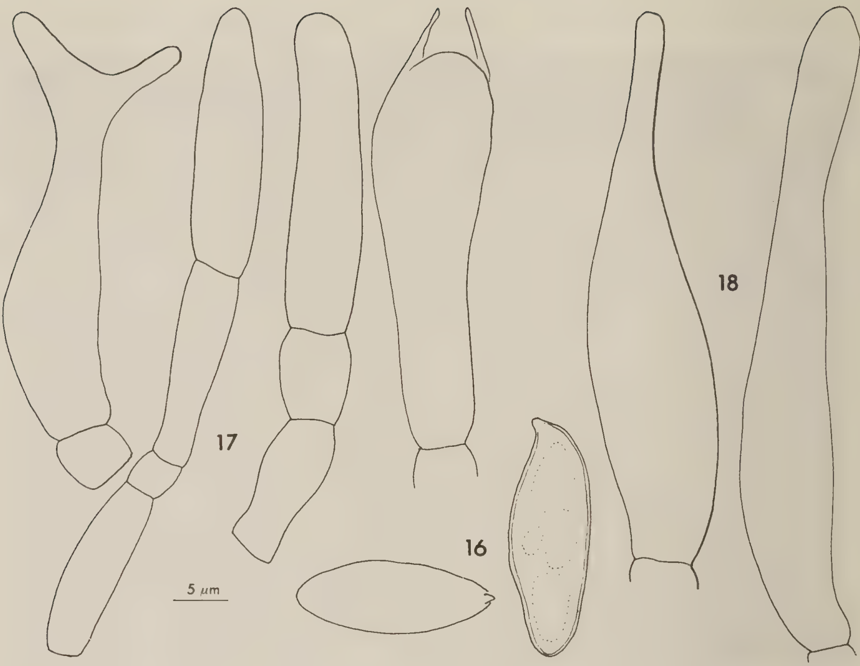
A speciebus aliis sectionis Luteoscabrorum, nocta semper cyanescens, coloribus uniformiter succineis vel brunneo-flavidis, pileipelle trichodermium cystidioideum revocanti, dermatobasidiis bisterigmatis, et cum Querco humboldtii consortione sua distinguenda.

Pileus (4)9-11.5 cm broad, convex to plane, dry, minutely subtomentose when young, subviscid to tacky and glabrous with age, grayish yellow (4B4) at the margin, darker near brownish yellow (5C6) on the disc when young, brass yellow (4C7) at the margin with age and raw sienna (6D7) at the disc, honey yellow (5D6) to light orange (5A5) to cinnamon brown (6D6) to amber yellow (4B6) in splotches, or brownish yellow (5C6-5C7) to yellowish brown (5D8-6D7); margin often sterile and projecting. *Flesh* 7-20 mm thick, whitish to yellowish white to orange white (4A2-5A2), bluing slightly near the tubes when exposed, but not intensely, slightly reddish-brown under the pileus surface. *Tubes* 3-20 mm long, depressed around the stipe, light yellow (2A5-3A5-3A6) when young, olive yellow (3D6) with age, bluing when exposed, boletoid; *pores* up to 2-3 per mm, yellow to deep yellow (3A7-4A8) when young (slight brownish discoloration) apparently stuffed, bluing when bruised. *Stipe* 3-12 cm long, 1-2 cm thick at apex, ±equal to subequal to subclavate to slightly enlarged below, strict or curved, dry, densely scabrous when young, less so with age; ground color pale yellow (4A3) when young, grayish yellow (4B4) with age, white at the base; scabers yellow (2A5) when young, yellow ochre to brownish yellow to light brown (5D8-5C8-5C7-5C6) to brownish orange to light brown (6C7-6D7,6,5) with age; interior solid, yellow (2A5) when young and bluing near the apex, marbled brown and white at the base.

Basidiospores olive brown to umber brown in fresh deposit, 14.7-23.8 × 6.3-8 μm (mean Q=2.88), smooth, subfusoid to ellipsoid, usually inequilateral with a suprahilar depression in profile, ochraceous in KOH, with dextrinoid walls in Melzer's. *Basidia* 31.5-40 × 12-15 μm, 4-sterigmate, clavate, hyaline. *Hymenial cystidia* moderately abundant, more common near pores, thin-walled, hyaline or rarely with homogeneous ochraceous content in apex, ventricose rostrate to lageniform or barely subfusoid to narrowly ampullaceous, 50-73 × 5-11 μm. *Tube trama* bilateral from a central strand that is sometimes tinged yellowish in KOH, otherwise hyaline, the lateral strata becoming subgelatinous, with elements 2-7 μm broad. *Pileus surface* a loosely interwoven trichodermium, with hyphae seemingly embedded in a hyaline matrix, yellow ochraceous in KOH, sometimes with ochraceous homogeneous contents, hyaline to pale ochraceous yellow in Melzer's, consisting of ±filamentous, branched, occasionally cylindric, suberect smooth-walled elements, with endcells 2.8-5.6 μm broad, sometimes cystidioid and then subcapitate to inflated or obtuse to slightly tapered, intercalary cells sometimes subisodiametric, arising from a layer of broader sphaerocyst-like hyaline hyphae, 12-30 × 10-21 μm broad. *Pileus trama* interwoven with hyaline hyphae, 3.5-10.5 μm broad. *Stipe surface* covered with isolated scabrosities, these sometimes fused-subreticulate, composed of versiform *caulocystidia*, narrowly lageniform to ventricose rostrate, subcylindric or sometimes filamentous with short-branched apices, hyaline and thin-walled, often arising from subisodiametric cells, 30-78 × 3-12 μm; *caulobasidia* 2-sterigmate, broadly clavate, generally hyaline, intermixed with caulocystidia. *Clamp connections* absent.



FIGS. 14–15. Habits of *Leccinum andinum*. 14. *Halling 5001* ×1/2. 15. *Halling 5052* (HOLOTYPE) ×1/2.



FIGS. 16-18. Microscopic features of *Leccinum andinum* (*Halling 5052*, HOLOTYPE). 16. Basidiospores. 17. Elements of stipe surface. 18. Hymenial cystidia.

TYPE: COLOMBIA. DEPT. ANTIOQUIA: Municipio Santa Rosa de Osos, near Llanos de Cuivá, 6°45'N, 75°30'W, ±2500 m elev, under *Quercus humboldtii*, 25 Nov 1986, *Halling 5052* (HOLOTYPE: HUA; ISOTYPE: NY).

Additional material examined: DEPT. ANTIOQUIA: Municipio Santa Rosa de Osos, near Llanos de Cuivá, 6°45'N, 75°30'W, ±2500 m elev, under *Quercus humboldtii*, 10 Nov 1986, *Halling 5001* (HUA, NY); 14 Nov 1986, *Halling 5027* (HUA, NY); Municipio San José de la Montaña, ±13 km S of San José de la Montaña along road to Labores, ±2500 m, under *Quercus humboldtii*, 26 Nov 1986, *Halling 5064* (F, HUA, NY).

Macroscopically this *Leccinum* approaches *Boletus morrisii* Pk. with regard to overall color schemes, but differs in bluing reactions (reddening in the latter), white basal mycelium (yellow in *B. morrisii*), and the pores are yellowish or rarely brownish in *L. andinum* (reddish in *B. morrisii*). Furthermore, *L. andinum* has larger spores (12-15.4 × 3.4-4.3 μm in *B. morrisii* [TENN 26054, 42113]), and the erect trichodermium composed of encrusted, broad, compact elements of *B. morrisii* contrasts markedly with the narrow diameter hyphae of the loosely interwoven trichodermium in *L. andinum*. The association with *Quercus*, the yellowish context, and yellow hymenophore clearly indicate section *Luteoscabra*, but consistent bluing reactions have not been reported in that section before. Other taxa of *Luteoscabra* that sometimes are cyanescent include *L. subglabripes* (Pk.) Sing. and its variants (Singer, pers. com.), but that species is differently colored on the pileus and stipe, has smaller spores, and the hyphae of the pileus surface form a hymeniform epithelium.

14. STROBILOMYCES CONFUSUS Singer, Farlowia 2: 108. 1945. FIG. 19

A few immature basidiocarps with an intact veil were found along with one basidiocarp that was over-mature. The spores from the latter are unmistakable and possess the "sparassoid" type of ornamentation characteristic for *S. confusus*. The dry, suberect, black squamules on the pileus, the gray and soon blackening hymenophore, reddening flesh on exposure, and woolly stipe surface further distinguish the species. Excellent descriptions are available in Singer (1945) and Smith & Thiers (1970).

Material examined: DEPT. HUILA: E of Parque Nacional Puracé, Finca de Ganadería Merenberg, under *Quercus humboldtii*, 21 May 1987, *Halling 5280* (NY).

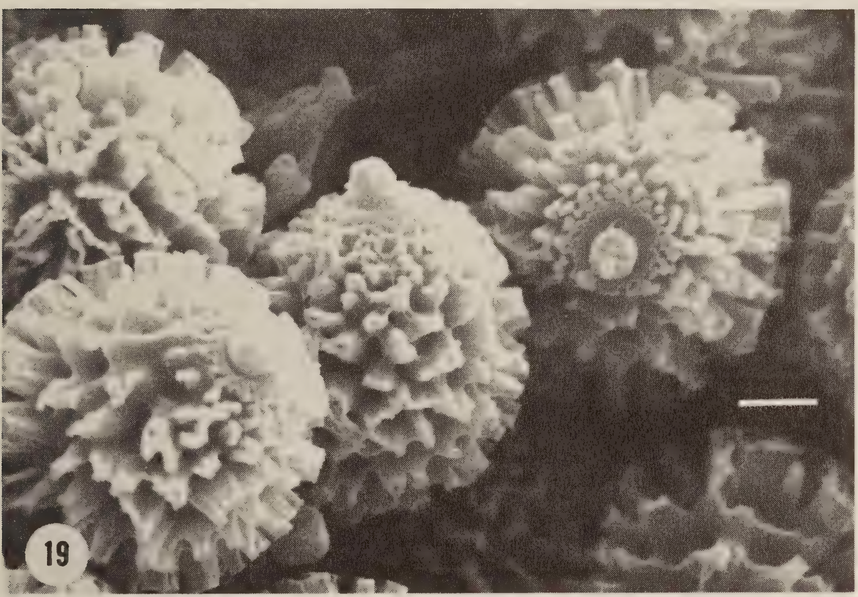


FIG. 19. Scanning electron micrograph, basidiospores of *Strobilomyces confusus* (*Halling 5280*). Standard line = 2 μm.

15. **TYLOPILUS OBSCURUS** *sp. nov.* FIGS. 20-23

Pileus usque 13 cm latus, brunneus vel griseobrunneus vel atrogriseus, tomentosus vel subvelutinus, atrogriseus quum dessicatus. Contextus pallidus, immutabilis. Tubuli pallidi tum subroseocinnamomei, immutabiles; pori brunneo-umbrini vel ochraceobubalini tactu cinnamomei. Stipes ±totus conspicue alveolatoreticulatus, pagina subroseocinnamomei; reticulum pileo concolor ad apicem pallidum aetate subcanescens compositum. Sporae 10.5-15.4(20) × 4.2-5.6 μm. Cystidia pigmentifera parietibus tenuibus.

Pileus 4-13 cm broad, convex then plane, dry, tomentose to subvelutinous to matted tomentose to matted velutinous, brown to dark brown to grayish brown to dark gray (7E-F5,4,3); margin slightly incurved to decurved, fertile, uplifted and irregular with age. *Flesh* near grayish orange (5B3) or whitish, unchanging, 1.5-2 cm thick, *odor* and *taste* mild. *Tubes* up to 12 mm long, subdecurrent or depressed, orange white (5A2) when young, near light pinkish cinnamon (6C5) at maturity, not changing when exposed or bruised; *pores* 1-2 per mm, cocoa brown to burnt umber to teak brown (6E-F6,5) when young, ochraceous buff (5B4) with maturity, near cinnamon (6D7) when bruised. *Stipe* 8.5-15 cm long, 1.3-4 cm thick, subclavate to ±equal, solid within and marbled white plus brown or black; surface near light pinkish cinnamon (6C5), alveolate-reticulate nearly to the base; reticulum concolorous with cap surface, concolorous with hymenophore above, grayish and compound with age.

Basidiospores tinted flesh-pinkish in a light deposit, subfusoid and inequilateral to ellipsoid or subcylindric, sometimes constricted or bent near the middle, smooth and thin-walled, ochraceous in KOH, usually pale ochraceous or a few dextrinoid in Melzer's, 10.5-15.4(20) × 4.2-5.6 μm (mean Q=2.71). *Basidia* clavate, 4-sterigmate, hyaline, 24-35 × 9-12 μm. *Hymenial cystidia* conspicuous, thin-walled, with granular, homogeneous, or coagulated and refractive orange brown content in Melzer's and uniform yellow brown or coagulated content in KOH, or more rarely hyaline and these more often near the pores, lageniform to fusoid ventricose to ventricose rostrate to subclavate rostrate, 42-63 × 8.5-12 μm. *Tube trama* bilateral; hyphae diverging from a pale ochraceous central stratum, 3.5-10.5 μm broad, with

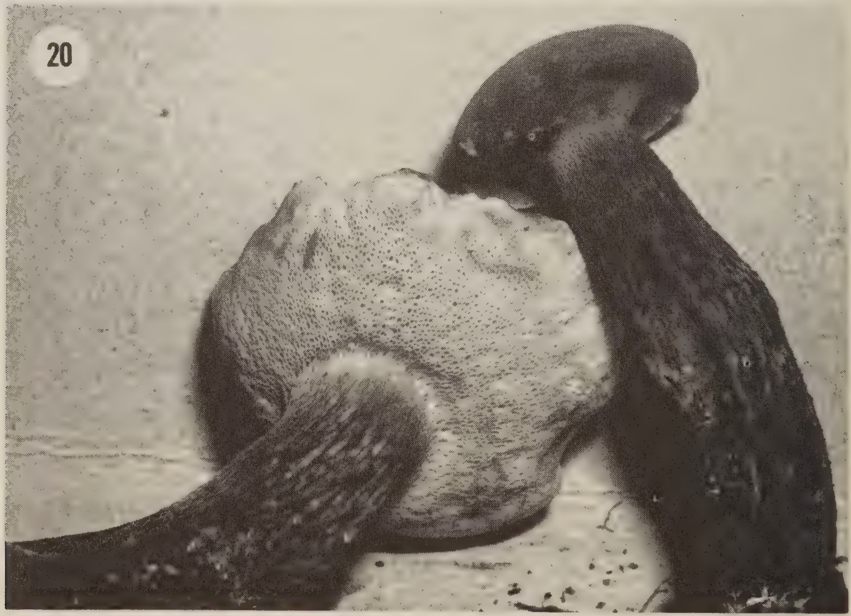
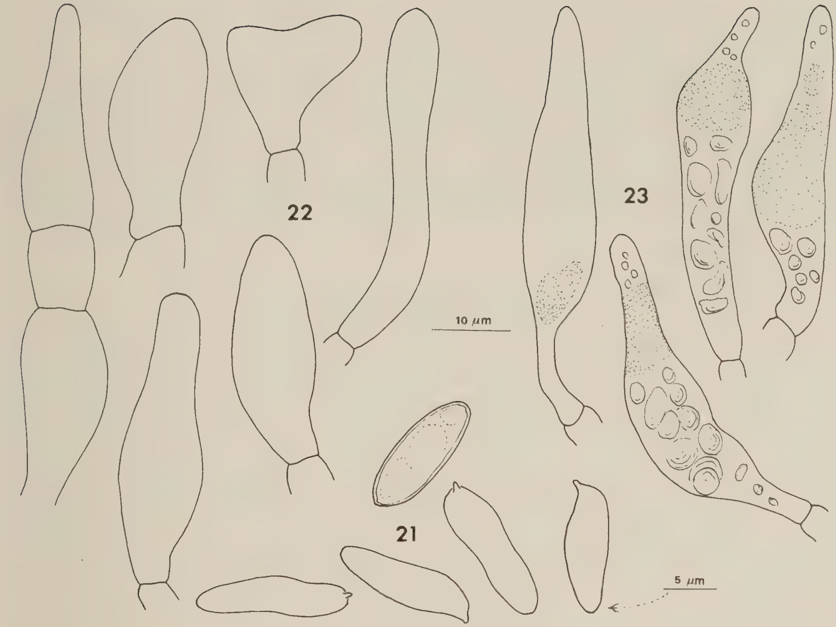


FIG. 20. Habit of *Tylopilus obscurus* (HOLOTYPE) ×3/4.



FIGS. 21-23. Microscopic features of *Tylopilus obscurus* (HOLOTYPE). 21. Basidiospores. 22. Elements of pileus surface. 23. Hymenial cystidia.

the lateral stratum becoming gelatinized. *Pileus surface* a palisade trichodermium, becoming more tangled and less erect with age, not encrusted but hyaline or with brown to olive brown vacuolar pigment, with elements cylindric to broadly clavate, subfusoid to cystidiiform or rarely subisodiametric, 11-45 × 5-15 μm, with obtuse apices. *Pileus trama* hyaline, interwoven, 3.5-10.5 μm broad. *Stipe surface* formed of long-cylindric, thin-walled, usually hyaline hyphae, 3.5-10.5 μm broad, that occur between the ridges of the reticulum, the latter composed of clavate to subfusoid, lageniform *caulocystidia* with contents similar to those of the hymenium. *Clamp connections* absent.

TYPE: COLOMBIA. DEPT. ANTIOQUIA: Municipio Guarne, Centro Experimental Piedras Blancas, ±14 km E of Medellín, 2350 m, *Cupressus*, *Eucalyptus*, *Pinus*, and *Quercus* nearby, 11 Nov 1986, *Halling 5008* (HOLOTYPE: HUA, ISOTYPE: NY).

Tylopilus obscurus is not close to any of the neotropical Tylopili discussed by Singer et al. (1983). However, there are a few somber-colored Tylopili with reticulated stipes known from the Old World that are similar (*viz. T. niger* (Heinemann & Goossens) C. B. Wolfe, *T. nigerrimus* (Heim) Hongo & Endo and *T. nigropurpureus* (Corner) Hongo). They differ from *T. obscurus* in important features: all have flesh that changes color when exposed, and some have shorter spores (*T. nigropurpureus*, *T. niger*), thick-walled cheilocystidia (*T. niger*), or olivaceous pigmentation (*T. nigerrimus*). An undescribed species from the eastern United States has black to gray tubes and pores, and tubes and flesh that change colors with exposure (Wolfe & Halling, *in ed.*).

Exotic plantings of *Pinus patula*, *Eucalyptus*, and *Cupressus*, along with stands of native *Q. humboldtii*, were located within 50 m of the collecting site. Although not unquestionably associated with *Quercus*, *T. obscurus* was growing in an area once recently forested by *Q. humboldtii* and may be associated with the oak roots. Clearly this is circumstantial evidence for an association with oak, and deserves further investigation.

ACKNOWLEDGEMENTS

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MYCOTAXON

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CLADONIA THIERSII: A NEW LICHEN FROM CALIFORNIA

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SUMMARY

Cladonia thiersii is described from northern California. It is compared to *C. subsubulata* Nyl. and *C. squamosa* (Scop.) Hoffm. var. *subsquamosa* (Nyl. *ex* Leight.) Vain. The identity of a long-disputed specimen from California labeled *C. santensis* in the Tuckerman collections in FH is clarified.

Cladonia sect. **Perviae** (Fr.) Matt.

Cladonia thiersii *sp. nov.* Fig. 1

Type: USA. California: Marin Co., Point Reyes National Seashore, Kehoe Beach, on humus, E facing, 50 m, 1988, *Hammer 2286* (Holotype: SFSU; Isotype FH); contains thamnolic acid.

> *Thallus primarius squamulosus, persistens, crassus, subcoralloides, partim infossus, ramosus infra substratum, ad 12 mm longus et 5 mm latus. Podetia fragilia, pulvinos densos formans, cinereo-virescentia, ad 30 mm alta et 4.5 mm lata, subcylindrica, parce dichotome ramosa, axillis perforatis vel clausis et sufflatis, cortex crassus vel rugulosus, verruculosus, squamulosus. Hymenia fusca; conidiomata gelatinum hyalinam continentia. Acidum thamnolicum continens.*

Primary thallus squamulose; primary squamules persistent, thick, forming extensive mats over surface of substratum, barely distinguishable from one another, deeply established in substratum, 4-12 mm long, 1-5 mm wide, irregularly dichotomously branched below surface of substratum, deeply laciniate, subcoralloid to irregularly lobate above; edges sinuate, to 0.3 mm thick, accessory lobules occasionally present; upper surface glaucescent green, sometimes with bluish tinge, subpruinose; ventral surface white, smooth to subfibrillose, upturned, esorediate or with granular soredia beneath upturned lobes. *Podetia* from upper surface of primary squamules, 4-30 mm tall, to 4.5 mm wide, subcylindrical, sometimes appearing inflated, forming scyphus-like openings at apices, sparingly to moderately branched; branches arising laterally or from margins of apical formations; cortex continuous to subcontinuous, sometimes disappearing, usually becoming quite thick above basal portions and appearing chinky-areolate to rugose to verruculose above; areoles or verruculae becoming elevated and appearing as closely appressed squamules, or enlarging and imbricating, or becoming upturned, in some podetia becoming abundant, breaking up and appearing as corticated granules; apices enlarging, often abundantly covered with peltate squamules, gradually opening, exposing smooth, whitish to chestnut brown interiors of podetia; closed apices enlarging and appearing inflated. *Apothecia* brown, borne in clusters around margins of apical openings, to 0.9 mm in diam; *ascospores* 8/ascus, hyaline, non-septate, oblong-ellipsoid, 6-16 × 3-6 μm; *pycnidia* brown, borne on margins; *conidia* hyaline, non-septate, straight to arcuate, 0.5-2 × 4-8.8 μm.

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[1] Present address: Farlow Herbarium, Harvard University, Cambridge, MA 02138.

Anatomy: Primary squamules 200-300 μm thick; cortex 35-60 μm thick, of tightly interwoven to adglutinated hyphal cells 7-10 μm in diam; algal layer 40-90 μm thick; medulla of densely packed, irregularly arranged, subcylindrical, sparingly branched hyphal cells 3-4.5 μm thick. Podetial wall 340-450 μm thick; outer layer of closely agglutinated cells, 40-60 μm thick; exterior medullary layer 250-300 μm thick; internal cartilaginous tissue 50-90 μm thick. *Hymenium* 20-44 μm thick; *subhymenium* 28-48 μm thick; *asci* 25-28 μm thick, clavate; *paraphyses* subcylindrical unbranched, 2-3 septate, 28-39 × 2-3 μm.

Spot test reactions: K^+ bright yellow, persistent; KC^+ yellow; P^+ deep yellow to orange.

Chemical constituents: Thamnolic acid with accessory substances F and G.

Specimens examined: CALIFORNIA. Marin Co.: *Hammer 2286* (TYPE), *Hammer 2302*, *2395*, *2407*, *2411*; Mendocino Co.: *Hammer 1522* (all SFSU); San Francisco Co.: *Bolander 30* (FH).

Cladonia thiersii is an intermediate species between *C. subsubulata* (=*C. carassensis* Vain.) and *C. squamosa* var. *subsquamosa*. TLC analyses demonstrate identical chemical constituents for this lichen and for the above named species. *Cladonia thiersii* is distinct on the basis of its morphology. Its podetia lack the wide lateral openings that are common in *C. subsubulata*. The axils of *C. thiersii* may be open or closed, whereas they are always open in *C. subsubulata*. The primary thallus of *C. thiersii* is persistent, the squamules thick and deeply established in the substratum, unlike *C. subsubulata* or *C. squamosa* var. *subsquamosa*, whose squamules lack these characters. The podetia of *C. thiersii* become inflated when there is no apical opening, a characteristic I have

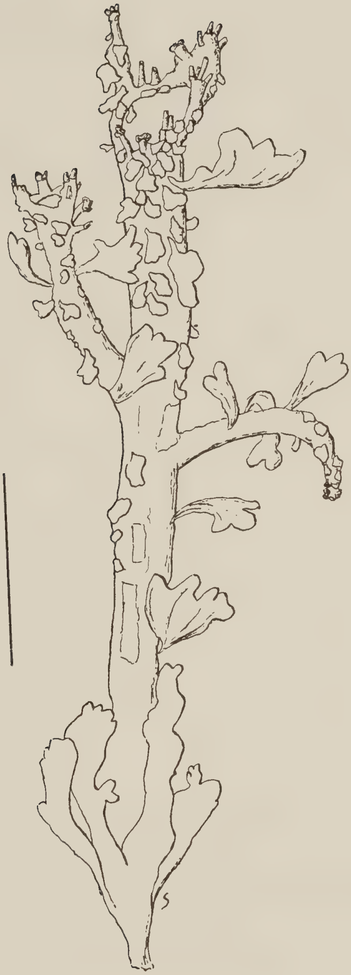

Fig. 1 Cladonia thiersii Hammer sp. nov. Scale bar =5mm

not observed in other members of sect. *Perviae*. Many podetia are densely squamulose, approaching *C. squamosa* var. *subsquamosa*. In *C. thiersii*, this state is often accompanied by a thick cortex, whereas in *C. squamosa* var. *subsquamosa*, densely squamulose podetia are usually decorticated.

This lichen has a long and confused history in California. A specimen collected by Bolander in 1863 from Mission Dolores (*Bolander 30*, FH) matches the type specimen of *C. thiersii*. Bolander sent his specimen to Tuckerman who called it *C. santensis*. The determination of this and several other specimens as *C. santensis* was considered by Nylander (Tuckerman, 1872) and later by Vainio (1887). Robbins (1927) summarized the controversy over Tuckerman's treatment of *C. santensis* and stated, "Tuckerman conceded to *C. santensis* a wide latitude." Robbins cited seven distinct species included in Tuckerman's concept of *C. santensis*, and determined *Bolander 30* to be "a young state of *C. crispata*." This latter specimen, however, contains thamnolic rather than squamatic acid, which is found in *C. crispata*. *Cladonia thiersii* bears a superficial resemblance to *C. crispata* but differs in its chemistry and morphology.

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STUDIES IN AGARICUS IV: NEW SPECIES FROM COLORADO

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Abstract

The history of Agaricus study in Colorado is reviewed. Two new species of Agaricus from the Rocky Mountains of Colorado are described. They are: Agaricus amicosus, section Spissicaules, and Agaricus cuniculicola, section Arvenses.

The recorded study of Agaricus in Colorado began shortly before the close of the nineteenth century, when E. Bethel sent some dried mushrooms which had been collected near the town of Craig to the New York State Botanist, C. H. Peck. This material formed the basis of A. tabularis Pk. (Peck, 1898). Peck (1905) subsequently renamed the Colorado fungus A. praerimosus Pk., addressing the conflict of priority posed by the earlier A. tabularis Pers. within the framework of the just-codified "rules of botanical nomenclature."

E. B. Sterling, a New Jersey resident (and namesake of the 1902 species A. sterlingii Pk.) visited Denver in 1903, collected mushrooms in and around the city, and sent his dried specimens to Peck. Based on this material, Peck (1904) published four new species of Agaricus, which are given here with their later synonyms (Peck, 1905), if any: A. solidipes Pk., A. rutilescens Pk., A. sphaerosporus Pk. (= A. pilosporus Pk.), and A. cothurnatus Pk. (= A. chlamydopus Pk.).

All five of these species were based on material collected in the plains to the east and west of the Rocky Mountains. With the exception of A. praerimosus, the "fairy rings" of which were studied extensively by Shantz and Piemeisel (1917), their natural history and their phenotypic variation in the field are undocumented. Today they are but very poorly known.

Kauffman (1923) discussed two species of Agaricus (as Psalliota) found in the high Rockies. One was determined as A. semotus Fr., whereas the other formed the basis of a revision of A. rutilescens Pk. Smith (1940) reassessed Kauffman's treatment of A. rutilescens. Both of these reports are pertinent to A. amicosus (described below), and will be discussed in that context.

No published reports on Agaricus of Colorado (other than type studies) have appeared since Kauffman's paper. There has been, however, a substantial amount of field research on the agarics of the Rockies, conducted by professional and amateur mycologists over the last several decades. Both A. H. Smith and H. D. Thiers, in particular, have spent portions of numerous "seasons" in this region, and both have related their impressions of the striking elements of the Rocky Mountain Agaricus mycota to me. My own observations from portions of three seasons spent in these mountains confirm and extend those of my recent predecessors.

Materials, methods, and conventions: Formulae for most of the reagents mentioned below are given in Kerrigan (1985). Some new reagent formulations are:

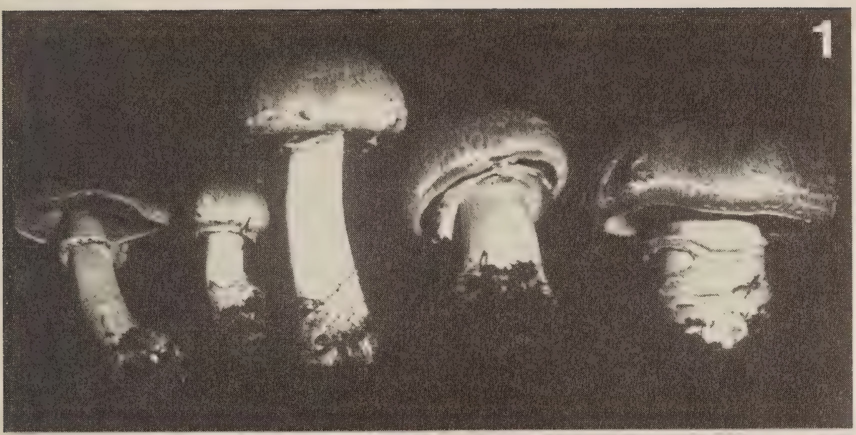
Syringaldazine: 10 mg in 10 ml of 95% ethanol (a saturated solution)
Ethanol: 95%, aqueous

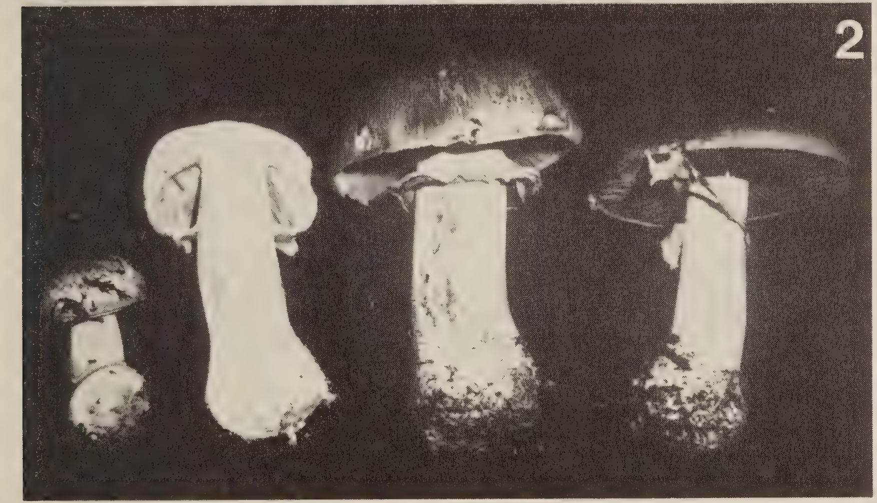
Color terms in single quotes are from Kornerup and Wanscher (1978). Other details of microscopy and terminology are given in Kerrigan (1985). Vouchers are deposited at SFSU or UCSB.

Agaricus amicosus Kerrigan, sp. nov. Figs. 1, 2.

Pileus 7-18 cm latus, maturitate late convexus, fibrilloso-squamosus, albidus, fibrillis appressis, initio pallide fulvus, aetate rufobrunneis praeditus; contextus ex albo rufescens; odor mitis, dulcis. Stipes 6-12 cm longus, apice 1.1-2.5 (-3.2) cm et basi 3.0-4.5 cm latus, clavatus vel modice bulbosus, e farcto cavus; contextus albus modice rubescens; superficies alba, tactu rufula vel flavida; velum pendens, album, margine bruneolum; sporae (5.0-5.4-) 6.0-6.7 (-7.2-8.0) x (4.4-) 4.8-5.3 (-6.2) μm; basidia 26.5-30.5 x 9-10.5 μm, tetraspora; cheilocystidia 13.5-20 x 6.5-11.5 μm. Holotypus: R. W. Kerrigan 1258, Robber's Roost C.G., Grand Co., Colorado. 21 August 1983. SFSU; Isotypus NY.

PILEUS 7-18 cm broad, at first hemispherical or semi-columnar to semi-cuboidal, becoming broadly to very broadly convex, the disc sometimes truncate or slightly depressed;





Figs. 1-2. Agaricus amicosus. Basidiocarps, x 1/3. 1. RWK 1258 (Holotype). 2. RWK 1259.

surface dry, variably fibrillose-squamose, the squamae ca. 5 mm long by 2-20 mm broad, usually appressed, somewhat concentrically arranged, or the squamae obscure and the surface essentially fibrillose, colored pale buff ('6B3') when young and protected to medium deep brown ('6C5'-'6D5'-'6D6'-'6E7'-'7E7') in age, background white, becoming pink to reddish brown when incised or bruised; context white, becoming light reddish to slightly vinaceous ('9B5'-'10C6') when exposed, especially above stipe and below disc, moderately firm, 7-22 mm thick, odor fruity/spicy.

LAMELLAE free, close (ca. 13 per cm at 1 cm from stipe), to 9 (-13) mm broad, when young pallid pinkish, becoming deep dingy pinkish with a slightly paler margin, then bruising rose color, later becoming drab brown, ultimately dark blackish brown.

STIPE 6-12 cm long x 1.1-2.5 (-3.2) cm above, 3.0-4.5 cm at base, clavate or essentially equal above a moderate to indistinct bulb; interior white, lustrous, becoming rather uniformly medium red ('9B5'-'9B6'-'10C6'-'10C7') when sectioned longitudinally, stuffed-hollow, the cavity to 6 mm broad; surface glabrous, with fine striations, white, becoming bright reddish orange ('9D7'-'8C7') or sometimes bright orangish yellow ('5A7') below, when bruised; basal 1-2.5 cm rooted in litter layer.

VEILS forming a moderately thin, pendant, subapical (to supramedian) white annulus with a thick (to ca. 3 mm), grooved, often brownish (like pileus surface) UV margin, also often forming a white, appressed volval boot with an appressed or slightly flaring brownish margin, or rarely a series of brown-tipped rings or only an obscure velar remnant above the base.

SPORES (5.0-5.4-) 6.0-6.7 (-7.2-8.0) x (4.4-) 4.8-5.3 (-6.2) μm, mean size = 6.29 x 5.02 μm (N=340, C=12), dark brown, broadly ellipsoid to ellipsoid, hilar appendix slightly prominent, germ pore not evident. BASIDIA 26.5-30.5 x 9-10.5 μm, clavate, predominately tetrasporic, absent from lamellar margin; sterigmata 2.5-3 μm long. CHEILOCYSTIDIA 13.5-30 x 6.5-11.5 μm, clavate to cylindro-clavate, or stocking-shaped, becoming brownish in age, then rehydrating poorly. PILEIPELLIS of straight, subparallel cylindrical elements of dimensions 33-43 (-78) x (4-) 8-9 μm.

CHEMICAL REACTIONS: KOH yellow or not on pileus surface, faintly to moderately strongly yellow on basal stipe context, slightly yellowish to negative elsewhere; Aniline x HNO_3 ("Schäffer reaction") red to orange (1/1 tests); ETOH orange on pileus surface (hence o-tolidine, syringaldazine, 1-napthol and 2,4-D orange in the absence of other color changes); o-tolidine blue (or orange; see ETOH) on pileus surface, blue on stipe base surface, violet elsewhere; 1-napthol bright pink to pinkish-orange everywhere (or with some purplish streaks in lower stipe context), to red on pileus surface (except disc sometimes purple); syringaldazine orange (see ETOH). [Note: the extracellular laccase isozyme phenotype of isolate RWK 1438 is given in Kerrigan and Ross (in press).]

Gregarious, often in rings or arcs, in deep litter under Picea and Abies, at elevations of 8500 to 10,000 feet, in the Rocky Mountains of Colorado. August. Routinely encountered.

Material studied: COLORADO. Boulder Co.: R. W. Kerrigan 1438. Grand Co.: RWK 1257, 1258, 1259, 1263, 1269, 1273, 1275, 1277, 1302, 1430, 1433, 1435, 1436, 1446. San Miguel Co.: RWK 1448, 1452. Misc.: RWK 1447.

Observations: In my experience, *A. amicosus* is the most frequently observed *Agaricus* in the high-elevation conifer forests of Colorado. Not only is it fairly common, but also the robust habit and red-staining context and surfaces of this brown-capped mushroom are distinctive. The impressions related by A. H. Smith and H. D. Thiers confirm that this striking species is quite familiar to those who study this habitat during the August rainy season. Judging from conversations with several collectors, it appears that *A. amicosus* has often been taken for *A. haemorrhoidarius* Schulz. in Kalchbr. One difference between these two species is the much narrower spore of *A. haemorrhoidarius*: 3-3.5 µm according to Cappelli (1984). Another way to distinguish *A. amicosus* from *A. haemorrhoidarius* is by chemical spot-tests on the pileus surface. The KOH (yellow), ETOH (orange), and positive Schäffer's reaction of *A. amicosus* are not shared by *A. haemorrhoidarius*, and suggest affinities with section *Spissicaules* (Heinem.) Kerrigan. The occasional tendency of the stipe cuticle to turn bright yellow-orange (e.g. RWK 1448) rather than bright red also appears to support this relationship. While perplexing to the uninitiated, this rather singular trait may ultimately shed light on the chemistry of these color reactions in the genus as a whole.

Agaricus amicosus is quite similar to the European *A. lanipes* (Möll.) Möll., another member of section *Spissicaules*. *Agaricus amicosus* differs from *A. lanipes* in habitat (high-elevation spruce-fir forests vs. lower-elevation oak forests), in chemistry (Schäffer's reaction positive vs. negative), and in spore size. The spores of *A. lanipes* are given by Möller (1950) as 5.5-6.5 x 3.75-4 µm, and by Cappelli (1984) as 5.5-6.5 x 3.5-4.5 µm. The spores of *A. amicosus* are slightly longer and substantially broader; the lowest *mean* spore width value recorded for *A. amicosus* (collection RWK 1302), with a 95% confidence interval of ±0.10 µm, is 0.37 µm larger than the *most extreme* spore width recorded by Cappelli, and is 0.87 µm broader than the broadest spores noted by Möller. Taking the mean spore size of *A. lanipes*, from Cappelli's data, as 6 x 4 µm, that species has a mean spore volume of 50.3 μm^3 (calculating the volume of the spore as $(4/3)\pi(L/2)(W/2)^2$). *Agaricus amicosus*, with a mean observed spore size of 6.29 x 5.02 µm, has a mean spore volume of 83.0 μm^3, 65% greater than that of *A. lanipes*. I suggest that the difference in spore size between the two species is most indicative of a long evolutionary divergence that warrants recognition of *A. amicosus* at the species level.

Kauffman's (1923) emended description of *A. rutilescens* is also evocative of *A. amicosus*. Kauffman described a frequently-encountered, large, brownish-capped, rufescent mushroom under spruce and fir at both sites he studied (Leal, in Grand Co., and Tolland, in Gilpin Co.). The points of discrepancy in his description, relative to A. amicosus as I have observed it, are a solid stipe [Kauffman's emphasis], a thin, narrow annulus, and spores which were reported as 5-6 x 4-4.5 μm. Smith later corrected Kauffman's spore measurements on the material to 5-6.5 x 4-5.5 μm, in good agreement with my own observations (ironically, Kauffman regarded Peck's spore measurements as being in error). The features of the annulus undoubtedly can be influenced by weather and environment, and in any event were described subjectively. Smith (1940) determined that Kauffman's material probably belonged to more than one species, since one collection had spores measuring 7-9 x 5-6 μm (I have also found such a large-spored collection, RWK 1449, among material of my own which was initially determined as A. amicosus). Smith recommended adherence to the type concept of A. rutilescens. I have examined neither the type of A. rutilescens nor Kauffman's material, and prefer to follow Smith's advice. It seems likely that Kauffman may have had A. amicosus in hand, as least in part, when he redescribed A. rutilescens.

The epithet amicosus, while suggestive of the gregarious habit of this mushroom, was actually chosen to celebrate the many friendships which are a hallmark of Harry Thiers' career.

Agaricus cuniculicola Kerrigan, sp. nov. Fig. 3.

Pileus 5-11 cm latus, ex acute convexo planus, appresso-fibrillosus vel fibrilloso-squamulosus, pallide coloratus, fibrillis initio brunneis demum fuscis praeditus; contextus albus, interdum aurantio-flavescens; odor amygdalinus; stipes 6-14 cm longus, apice 0.8-1.5 cm et basi 2-3 cm latus, bulbosus vel abrupte bulbosus, e farcto cavus; vela pendentia, interdum recurvo-pendentia, margine et pagina inferiore aurantia vel bubalina; sporae (5.0-5.4-) 6.2-6.9 (-7.6-8.0) x (4.2-) 4.6-5.6 (-6.2) μm; basidia (17.5-) 22.5-27.5 x 8-11 μm, tetraspora; cheilocystidia 7-30.5 x 6.5-18.5 μm. Holotypus: R. W. Kerrigan 1271, Willow Creek Pass summit, Grand Co., Colorado. 22 August 1983. SFSU; Isotypus NY.

PILEUS 5-11 cm broad at maturity, less than half the diameter of the stipe in primordia, acutely convex when young, ultimately becoming semi-plane with a slightly depressed or slightly umbonate disc; surface dry, innately appressed-fibrillose, becoming appressed-fibrillose or minutely fibrillose-squamulose (except the disc remaining entire), the squamules ca. 1-3 mm long x 1-2 mm broad, these hyphae initially medium brown (about '6C4'-'6C6'-'7C5'-'7D6') or paler, becoming darker in age (to about '7E8' or darker) on a whitish (to yellowish in age) back-

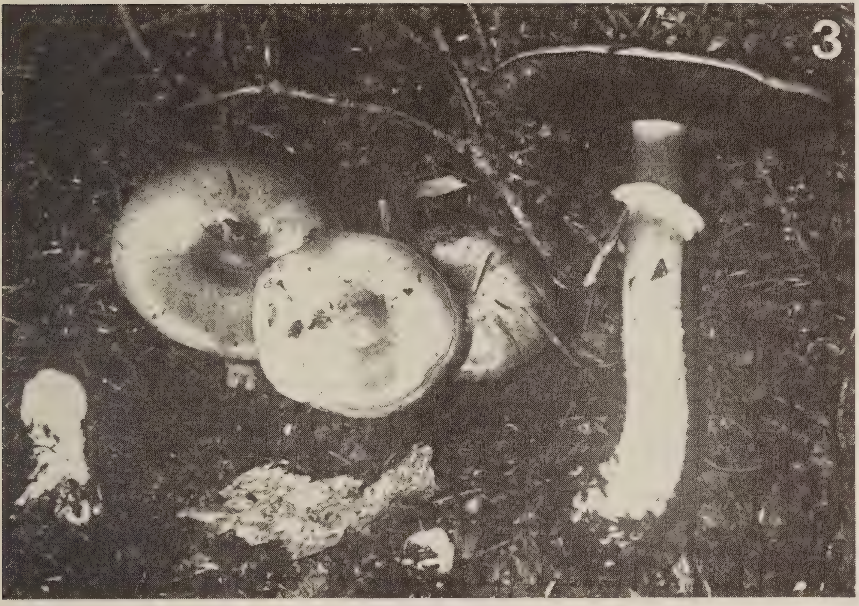


Fig. 3. Agaricus cuniculicola RWK 1271 (Holotype). Basidiocarps, x 1/3. Note three basidiocarps that formed in small tunnels, with pilei just protruding above substrate surface.

ground; context white, unchanging when young, becoming orangish in older material when exposed, 6-10 mm thick, odor of almonds.

LAMELLAE free, close (ca. 16 per cm at 1 cm from stipe), 6-12 mm broad, initially pallid, then greyish-drab and faintly marginate or not, color unchanging when bruised, finally dark blackish brown.

STIPE 6-14 cm long x 0.8-1.5 cm broad above, 2-3 cm broad at base, bulbous to abruptly bulbous; interior white, unchanging in young material, or becoming orangish in older material, when exposed, lustrous, fibrous, stuffed-hollow to hollow, the cavity 3-4 mm broad; exterior white, lustrous, becoming yellowish when bruised, finely striate above, covered below with numerous scattered, small, white, floccose velar squamules, these deciduous in age, lower surface lustrous, finely fibrous-striate; basal bulb covered with coniferous litter.

VEILS forming a thin, pendant to pendant-recurved, sub-apical, white (or later orangish-yellow) annulus, with a finely striate upper surface and a scurfy, sometimes buff colored lower (UV) surface, the margin slightly thicker, somewhat eroded, orangish-buff; the UV also leaving scattered scurfy squamules over most of the lower stipe.

SPORES (5.0-5.4-) 6.2-6.9 (-7.6-8.0) x (4.2-) 4.6-5.6 (-6.2) μm, mean size 6.58 x 5.05 μm (N=150, C=5), dark brown, broadly ellipsoid to ellipsoid (with many hyaline subglobose immature spores often also present), hylar appendix not prominent, germ pore not evident. BASIDIA (17.5-) 22.5-27.5 x 8-11 μm, clavate to cylindro-clavate, predominately tetrasporic, extending to edge of lamellar margin; sterigmata 3.5-4 μm long. CHEILOCYSTIDIA 7-30.5 x 6.5-18.5 μm, globose, ovoid, ellipsoid, or various, catenulate, abundant but restricted to the center of the lamellar margin. PILEIPELLIS of parallel to subparallel hyphae composed of straight, cylindrical elements of dimensions (15-) 33-47 (-56) x 6.5-9.5 μm.

CHEMICAL REACTIONS: KOH yellow; o-tolidine blue everywhere; 1-napthol purple at base of stipe and on cuticles (slowly so on context near base of stipe), pink elsewhere.

Gregarious to scattered in litter of Picea and/or Abies, particularly in deep piles of decaying cone scales that result from the feeding activities of squirrels; the primordia sometimes form several cm beneath the surface, on the walls of short tunnels apparently excavated by small mammals; from ca. 8500-10,000 feet in the Rocky Mountains of Colorado. August. Fairly frequently encountered.

Material studied: COLORADO. Boulder Co.: R. W. Kerrigan 1439. Grand Co.: RWK 1271, 1272, 1278, 1279, 1301, 1431, 1432, 1445. San Miguel Co.: RWK 1453.

Observations: Agaricus cuniculicola, when slender, most closely resembles A. smithii Kerrigan (= A. perrarus sensu A. H. Smith, 1940) of the coastal Pacific Northwest, differing macroscopically only in having a brownish cuticular pigment when immature, rather than the tawny orangish pigment of A. smithii. The overall aspect of these two species, including a narrowly convex pileus when young, a bulbous stipe base, and frequently a pendant-recurved annulus, suggest a close relationship between them. Other, more robust collections which resemble pale specimens of A. augustus Fr., or brownish forms of A. perobscurus Kerrigan, may also belong to A. cuniculicola. Such material that I have obtained has unfortunately been too immature for microscopic analysis. If these variants are all conspecific, then A. cuniculicola has a fairly wide range of aspects. This makes field identification problematic, particularly since members of Agaricus section Arvenses Konrad & Maublanc are well represented in the high Rockies.

Microscopically, the spores of A. cuniculicola are shorter than those of A. smithii. Mean values for spore length from eleven collections of A. smithii ranged from 8.3 µm down to 7.5 µm, whereas mean spore lengths for collections of A. cuniculicola ranged from 6.3 to 6.8 µm. The mean spore width of A. cuniculicola varied more between collections than did mean spore length, ranging from 4.6 to 5.6 µm. The difference in mean spore volumes (116.3 μm^3 for A. smithii vs. 89.2 μm^3 for A. cuniculicola) is about 30% of the mean spore volume of A. cuniculicola.

The pink color formed by 1-napthol when placed on some of those areas of the context which turn blue with o-tolidine has not been recorded previously in other species; a blue tolidine reaction usually correlates with a purple napthol reaction. This unusual combination of reactions may have to do with the biochemistry of the orangish hue that develops in older context when exposed.

Although not restricted to tunneled piles of cone-scales, in my experience A. cuniculicola fruits most abundantly there. Its association with this "naturally-manufactured" feature of the high coniferous forests of the Rockies is striking enough to have been noted by other collectors, among them H. D. Thiers (pers. comm.). This association is reflected in the species epithet.

ACKNOWLEDGMENTS

I would like to express my gratitude to those who interested me with their tales of the Colorado mountain species of Agaricus (including my mentor and his mentor), and to those who guided my way in the field, offered shelter and company, and made it financially feasible to work in their state. Marilyn Shaw, Linnea Gillman, Duane H. Mitchel, and many other members of the Colorado Mycological Society, Emmanuel Salzman and Fungophile, Inc., deserve special mention. I thank David Farr for checking the priority of the proposed names, Robert Patterson for the covert loan of material housed at SFSU, and Roy Halling and Wayne Ferren for their comments on the manuscript. I am particularly grateful to Ellen Thiers for rendering the taxonomic diagnoses into Latin.

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MYCOTAXON

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A NEW, LIGNICOLOUS SPECIES OF *ENTOLOMA* (Entolomataceae, Agaricales) FROM CALIFORNIA.

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SUMMARY

A new species of *Entoloma* (sensu stricto), *E. lignicola*, that grows on conifer wood is described from northern California.

INTRODUCTION

In November of 1986, at least 200 basidiomes of a species of *Entoloma* (sensu stricto) were found growing on a conifer log in northern California. A collection of nearly 50 basidiomes in all stages of development was made. Because of the following set of features, this species was considered distinct and unusual: woody substrate, consistently convex, tan pileus with a margin extending beyond the lamellae, close, narrow lamellae, curved, slender stipe, obscurely angled, isodiametric, small basidiospores, and a narrow cutis as the pileipellis. A careful review of the pertinent literature resulted in the conclusion that this species had not been previously described.

Therefore, it is with pleasure that I dedicate this species, *Entoloma lignicola*, to Harry D. Thiers.

Entoloma lignicola Largent, *sp. nov.*

Pileus 20-45 (-55) mm latus, convexus vel lato-convexus, glaber, tannus, haud hygrophanous, margine decurvato, integro, non-striato. Lamellae adnatae, albae, angustatae, confertae. Stipes 3-5 (-6) mm crassus, 25-60 mm longus, glaber, subalbus. Odor et sapor farinceus. Sporae 5.1-6.1 x 4.1-5.1 μm, isodiametricae, obscuro-angulatae. Hymenial cystidia desunt. Pileipellis cutiformis, cellulis terminalibus cylindro-clavaticis. Stipitipellis cutiformis; caulocystidia desunt. Pigmentum in vacuolis hypharum. Fibulae in hyphis pileipellis, pileal trama, lamellar trama, stipitipellis, stipe trama, et basi basidiorum adsunt. Basidiocarpi dispersi vel gregarii ad lignum in sylvis sub Lithocarpum, Arbutum, et Pseudotsuga . Holotypus (DLL 8747) in HSU conservatus.

Pileus: 20-45 (-55) mm in diameter, 10-20 mm in height, consistently broadly convex and without an umbo, glabrous, dull, dry, with an incurved to decurved, non-translucent-striate margin that consistently extends beyond the lamellae by 1-3.5 mm, not hygrophanous, colored at first an off-white to a pale buff (6,A-B,3 to 6,B,3), soon becoming and remaining a uniform tan (6,C-D,5); pileal flesh concolorous with the surface, 1.5-2.5 mm thick. Lamellae: adnexed to adnate at first becoming typically adnate, narrow to somewhat moderately broad (3-7 mm high, 10-30 mm long), typically close to rarely subdistant, colored white at first, with a smooth margin concolorous with the surface. Stipe: 3-5 mm thick at the apex, 3-6 mm thick at the base, 25-60 mm long, most often equal but at times tapered towards the apex, usually entirely glabrous but at times with a slight pruinose apex, decidedly curved towards the light and away from the ground, thus negatively geotrophic and positively phototrophic, colored an off-white, obscurely longitudinally striate, with a sparse to moderate, whitish basal tomentum. Odor and taste: farinaceous, especially when the flesh of the pileus is crushed.

Spores 5.1-6.1 x 4.1-5.1 μm, average length 5.44 μm, average width 4.85 μm, Q (average length/width) 1.12, length/width 1.0-1.33, length minus width 0-1.5 μm, isodiametric, multiangular with the angles typically obscure, even in outline and with no protrusions or outgrowths. Basidia clavate, 25.4-33.5 x 6.1-8.1 μm, length/width 3.3-5.0, 4-spored. Hymenial cystidia absent. Subhymenium in cross section a tightly interwoven layer, up to 24.6 μm wide, composed of small, slender hyphae, 3.7-4.9 μm wide. Lamellar trama in cross section composed of subparallel hyphae, 71.4-172.4 x 12.3-17.3 μm. Pileal trama in radial section composed of interwoven hyphae above the stipe and hyphae parallel to the pileal surface above the lamellae; hyphae 36.9 -135.5 x 7.4-29.6 μm, with the broader hyphae more abundant beneath the pileipellis. Pileipellis in radial section a cutis, 2-6 hyphae thick, with the hyphae more slender than, and thus differentiated from, the underlying hyphae of the pileal trama, composed of slightly entangled hyphae over the stipe and parallel hyphae elsewhere; terminal cells cylindro-clavate to somewhat broadly clavate, 24.6-69.0 x 6.2-9.9 μm, length/width 3.3-11.2. Stipitipellis composed of a very narrow layer of loosely interwoven hyphae overlying a layer of parallel hyphae; caulocystidia absent. Pigmentation apparently vacuolar, distinctly not incrusting or membranal. Lactifers quite rare, more common in the trama of the stipe and the lamellae than in the pileus trama. Clamp connections extremely rare on the hyphae of the pileipellis, moderately abundant on the tramal hyphae of the pileus and stipe, abundant on the tramal hyphae of the lamellae and at the base of the basidium, rare on the hyphae of the stipitipellis.

Distribution and Habitat: Rare, collected only once; scattered to gregarious on a slightly decomposed conifer log in a Tanbark Oak (*Lithocarpus densiflorus* (Hook. & Arn.)Rehd.), Douglas fir (*Pseudotsuga menziesii* (Mirbel)Franco), Madrone (*Arbutus menziesii* Pursh.) forest; Humboldt County, California; mid-November.

Material Studied: CALIFORNIA: Humboldt Co.: DLL 8747 (HOLOTYPE: HSU; 16 November 1986, 5.0 miles east from the junction of Big Hill Road and State Highway 96)

An unsuccessful attempt at identifying this species was made utilizing the following pertinent literature: Horak (1973, 1978, 1980), Kühner & Romagnesi (1953), Noordeloos (1981, 1987), and Romagnesi & Gilles (1979).

On the basis of its small basidiomes, convex, tan pileus, narrow, adnate lamellae, rather slender stipe, farinaceous odor, small, obscurely angular, isodiametric basidiospores, cutis as the pileipellis, and lignicolous habit, *Entoloma lignicola* appears to be a unique species.

Because of its non-hygrophanous, non striate, glabrous pileus, it appears related to *Entoloma niphoides* Romagn. ex. Noordel., *E. eulividum* Noordel., *E. sinuatum* (Bull.:Fr)Kumm., and *E. prunuloides* (Fr.:Fr.)Quél. However, all of these species have much larger spores, a humicolous habit, a pileus that is up to 100-125mm broad, and a *Tricholoma*-like stature.

Because of its basidiome colors, convex pileus with thin flesh, and farinaceous odor, *Entoloma lignicola* appears also to be related to *E. rhodopolium* and *E. speculum* (Fr.:Fr.)Kummer. However these species are distinct because of their hygrophanous pileus with a striate margin, humicolous habit, and larger basidiospores that are distinctly angular.

On the basis of its small, obscurely angular basidiospores, *Entoloma lignicola* could be placed in *Entoloma* section *Turfosa* (Romagn.)Noordel. However, all species in this section possess a hygrophanous pileus with a striate margin, grow in the humus, and possess basidiomes that are much darker in color.

Colors from Kornerup and Wanscher (1978) are quoted by page (first number), horizontal row (letter), and vertical column (last number).

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NOTES ON THE GENUS PROTUBERA (PHALLALES)

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ABSTRACT

The genus Protubera includes species of Phallales that are essentially gasteromycetous. Basidiomata are composed of a thin peridium enclosing a gelatinous matrix. Fertile glebal plates or chambers extend inward from the peridial layer and eventually fill all or part of the interior. There are seven described species of Protubera: P. africana, P. borealis, P. brunnea, P. clathroidea, P. jamaicensis, P. maracuja (the type species), and P. nipponica. An eighth species, P. sabulonensis is described as new to accommodate collections from primary sand dunes on Sable Island, Nova Scotia, Canada. All of the species are briefly characterized, including notes on type and other collections, illustrated in part and differentiated by a dichotomous key.

INTRODUCTION

In 1890 Alfred Möller, while collecting fungi near Blumenau, Santa Catarina, Brazil, encountered a gasteromycetous form that closely resembled an unexpanded "egg" of one of the Phallales. This fungus was common in the region and fruited abundantly throughout the year. He was able to study it closely throughout its development and determined that it remained in the closed gasteromycetous form right through to its final dissolution. After his return to Germany he determined this fungus to represent a new genus of Phallales and described it as Protubera maracuja Möller (Möller, 1895). In that paper developmental stages and mature basidiomata were well illustrated, and these were later reproduced by Fischer (1900). Since then this fungus has been collected a number of times and reported from various parts of the world; Furtado & Dring (1967) accumulated and presented most of these records, although they accepted as correctly identified only material from southern Brazil.

As described by Möller, basidiomata of P. maracuja first appear as brown, spherical to elongated structures. They are attached to the soil by stout rhizomorphs and consist of a compact peridial layer surrounding a gelatinous center. During maturation, hyphal plates or lobes grow into the central gelatinized tissue from the peridium and give rise to internal labyrinthine cavities lined with basidia. Cross sections of mature basidiomata reveal a number of radially arranged fertile lobes connected by narrow strands to the inner surface of the peridium and extending halfway or more into the center.

Lloyd (1920) received additional material of *P. maracuja* from Rev. Rick in Brazil, who stated that it is not rare, but added nothing to Möller's description. In the same paper Lloyd reported on a species collected in Stellenbosch, South Africa by Miss A. V. Duthie and described it as a new species, *P. africana* Lloyd. This species was said to differ from *P. maracuja* in having a single glebal mass filling the center of the basidiomata rather than radiating plates. The glebal mass was described as "compact and minutely porous to the eye" and similar to that of *Rhizopogon* species.

A third species, *P. borealis* Imai was proposed by Imai (1936) to accommodate a collection from soil in *Cryptomeria japonica* (L.) D. Don. forests near Sapporo, Hokkaido, Japan. *P. borealis* was reported to be similar to *P. maracuja* and to differ from it in having slightly larger spores and a nearly white peridium.

Kobayasi (1938) described the new species *P. nipponica* Y. Kob. for a collection from soil in the woods near Kunitati, Honshu, Japan, said to be similar to *P. maracuja* and *P. borealis* but differing in having a hollow center caused by the disintegration of the gelatinous matrix. The glebal plates were described as greatly elongated and extending nearly to the center of the basidiomata.

Imai & Kawamura (1958) obtained material of *P. maracuja* from Dr. Rick in Brazil and compared it directly with the two Japanese species. Based on the nature of the peridial and glebal tissues these authors proposed two new genera for the Japanese species; *Protuberella* for *P. borealis* and *Kobayasia* for *P. nipponica*. Interpretation of this paper is rather difficult, but the following key may reflect Imai & Kawamura's views:

1. Peridium composed of three distinct
   layers .... *Protubera maracuja*
1. Peridium composed of two layers 2

    2. Basidiomata hollow at the
       center .... *Kobayasia nipponica*
    2. Basidiomata gelatinous at the
       center .... *Protuberella borealis*

A fifth species of *Protubera*, *P. clathroidea* Dring, was proposed by Dring (1964) for a form collected in sandy places in Togo and also one reported as *P. maracuja* from Pakistan by Ahmad (1952). In *P. clathroidea* the glebal plates appear to be united into a single mass. This species was reported to be similar to *P. africana* Lloyd and to have similarly broad basidiospores. Unlike *P. africana*, *P. clathroidea* has basidiomata with a sterile gelatinous center.

Two further species, *P. brunnea* (Zeller) Zeller and *P. jamaicensis* (Murrill) Zeller must be included in this discussion. *Protubera jamaicensis* was originally described as the type species of *Protophallus* Murrill (Murrill, 1910). *Protophallus* was apparently described without knowledge of *Protubera* and was maintained as distinct from it by Zeller (1939) and Imai & Kawamura (1958) apparently on the basis of a simple rather than branched columella (central gelatinous area). Zeller (1948) later rejected the distinction and transferred the two species of *Protophallus* to *Protubera*, a decision accepted by Dring (1964). *Protubera jamaicensis* and *P. brunnea* were not originally compared with species of *Protubera* and are thus not easily distinguished from them on the basis of their diagnoses. *Protubera jamaicensis* was reported to be characterized by a viscid peridium and *P. brunnea* by broadly ellipsoidal basidiospores (5-6 X 2.5-3 µm).

During October, 1982, I spent three weeks studying fungi on Sable Island, Nova Scotia. This island is a narrow bar of sand about 200 km east of the Nova Scotia mainland that supports a surprisingly varied vegetation. The foredunes on the north side of the island are relatively unstable and support a vegetation dominated by *Ammophila breviligulata* Fern. (Graminae) and *Lathyrus maritimus* (L.) Bigel. (Leguminosae). This habitat was generally rather poor for fungi, but I nevertheless found abundant basidiomata of a species of *Protubera*. Although descriptions were available for all of the described species of *Protubera* it quickly became apparent that species concepts were confused or not well defined and that identification of my unknown specimen was nearly impossible. Because of this, it became necessary to examine representative material of some of the species similar to the Nova Scotia collections and to arrive at a more satisfactory concept of existing species. The following notes are based on these examinations. Colors designated in upper case are according to the Methuen Handbook of Colour (Kornerup & Wanscher, 1978).

THE SPECIES OF *PROTUBERA*

PROTUBERA AFRICANA Lloyd, Mycological Notes 64: 987. 1920.

Figs. 1-3.

BASIDIOMATA (Fig. 1) more or less spherical, smooth, pale brown; in cross section revealing four separate tissues, 1) a thin brown peridium, 2) a soft gelatinous layer about 3 mm thick, 3) a thin internal membrane surrounding 4) a central glebal mass. RHIZOMORPHS stout, extending into the soil. ODOR not specified.

OUTER PERIDIAL LAYER compact, 52-96 µm thick, brownish, composed of tightly interwoven non-gelatinized hyphae, never enclosing druse-like crystalline masses. GELATINOUS AREAS 600-700 um thick, composed of interwoven, septate, gelatinous hyphae, containing numerous oleiferous hyphae, sometimes containing a tissue similar to the peridium that is oriented parallel to the peridium. GLEBAL MASS filling the center of the basidiomata, reticulate-poroid as in species of Rhizopogon, bearing basidial hymenia within the chambers, connected to the peridium by narrow bands of tissue. BASIDIA (Fig. 2) 8-spored, short-sterigmate, 21-33 X 4.2-7.2 µm. BASIDIOSPORES (Fig. 3) ellipsoidal, smooth, with a conspicuous basal apiculus, greenish olive in mass, 4.6-6.2 (mean = 5.1 ± 0.44) X 2.0-2.8 (m = 2.4 ± 0.17) µm, with mean D/d = 2.09 ± 0.19).

MATERIAL EXAMINED: SOUTH AFRICA: Stellenbosch, Papagaaisberg, in damp clayey soil, Duthie 233 (Lloyd 22143), 20.VI.1919, HOLOTYPE (BPI); possibly same locality as holotype, Duthie 243 (Lloyd 22144) (BPI).

The macroscopic part of the description is based on that of Lloyd (1920) who presumably had a description from Miss Duthie, the collector. The holotype packet also contains a colored drawing of fresh material, redrawn in Fig. 1. This drawing indicates that there are strands connecting the peridium to the gleba as in other species, although Murrill states that no such structures are present. I was unable to observe these in the herbarium specimens, but the parallel layer that resembled to me a second embedded peridium may in fact have been one of these connections. This is the only species of Protubera where the glebal masses appear to be combined into a single central unit. As Lloyd pointed out, the resemblance of the gleba to that of Rhizopogon species is striking.

PROTUBERA BOREALIS (Imai) Imai & Kawamura, Sci. Rep. Yokohama Nat. Univ. Sect. II, 7:4. 1958.
≡ Protuberella borealis Imai, Bot. Mag., Tokyo 50:223. 1936.

Figs. 4-6.

BASIDIOMATA (Fig. 4) arising from a rhizomorph, uneven to wrinkled or clearly sulcate, grayish white to pale sordid, 20-50 mm in diameter; in cross section there appear to be four tissues, 1) a thin pale compact peridium, 2) a rigid, gelatinous peridium-like layer 1-3 mm thick, 3) a thin gelatinous "filling", and 4) centripetally arranged glebal plates extending inward from the peridium. RHIZOMORPHS white, gelatinous within, branched. ODOR not recorded.

PERIDIUM compact, 230-360 um thick, pale, composed of interwoven, occasionally clamped hyphae with globose to oblong or cylindrical cells 8-20 um in diameter, without crystalline masses. GELATINOUS AREAS composed of interwoven gelatinous hyphae up to 9 um in diameter, rather firm near the peridium and glebal masses and highly gelatinous and watery elsewhere, sometimes containing capitate hyphae 12-18 um in diameter. GLEBAL MASSES radiating inward from the peridium, short and often cerebriform. BASIDIA (Fig. 5) clavate to irregularly cylindrical, 8-spored, clamped at base, 14-20 X 2.8-4.9 µm. BASIDIOSPORES (Fig. 6) ellipsoidal, smooth, with a broad basal apiculus, Grayish yellow to Olive brown (4CD3) in mass in rehydrated material, 3.8-4.7 (mean = 4.2 ± .020) X 1.6-2.1 (mean = 1.8 ± 0.13) µm, with mean D/d = 2.36 ± 0.205.

MATERIAL EXAMINED: JAPAN: Tottori Pref., Tottori-City, Kokoge, gregarious in stand of _Quercus_ _myrsinaefolia_ Blume in woods dominated by _Pinus_ _densiflora_ Siebold & Zaccarini, _Nagasawa_, 16.VII.1980 (TMI-6948) (TRTC).

The material examined here seems close enough to the original description of _P_. _borealis_ to cause little doubt as to its identity. The holotype was collected in forests of _Cryptomeria_ _japonica_ (L.) D. Don. near Sapporo, Ishikari Prov., Hokkaido, Japan. The one point of disagreement is in spore size: that given by Imai (1936) was 3.75-4.5 X 2-2.5 µm which is broader than the spores of the Tottori material. The species is distinguished from other _Protubera_ species by its combination of short glebal masses, soft or almost watery gelatinous material and relatively narrow basidiospores.

PROTUBERA _BRUNNEA_ (Zeller) Zeller, Mycologia 40: 644. 1948.
≡ _Protophallus_ _brunneus_ Zeller, Mycologia 31: 28. 1939.

BASIDIOMATA arising from a rhizomorph, spherical, smooth but somewhat felty, white, becoming sordid, reticulate with a few lines, 15-35 mm in diameter; in cross section there appear to be four separate tissues, 1) a thin tough peridium, 2) a rigid gelatinous peridium-like layer 2-4 mm thick, 3) a thin gelatinous "filling, and 4) centripetally arranged glebal plates extending inward from the peridium. RHIZOMORPHS white, apparently unbranched, with a peridium-like cartilaginous sheath and a gelatinous center, extending nearly into the center of the basidiomata. ODOR not specified.

PERIDIUM compact, about 175-250 µm thick, composed of interwoven and anastomosing non-gelatinous hyphae, with crystalline masses not reported. GELATINOUS AREAS composed of interwoven anastomosing, highly gelatinous hyphae. GLEBAL MASSES arising as ingrowths of the peridium, less gelatinous than the surrounding tissues, extending nearly to the center of the basidiomata, giving rise to a regular hymenium of basidia internally. BASIDIA elongate-clavate, 4-6-spored. BASIDIOSPORES broadly ellipsoidal, smooth, brown in mass, 5-6 X 2.5-3 µm.

MATERIAL EXAMINED: none. The above description has been taken from that of Zeller (1939) and transformed into the standard format of this paper.

Protubera brunnea appears to be distinctive in having the rhizomorph extending well into the center of the basidioma and in having large broad basidiospores. The type (now at FH) was collected by Roland Thaxter in a park, Buenos Aires, Argentina in February and March 1906. The type locality is not so distant from that of P. maracuja that it does not force comparison with it. However, the two diagnostic features mentioned above, as well as the white, filamentous peridium of P. brunnea, seem to distinguish them.

PROTUBERA CLATHROIDEA Dring, Mycol. Pap. CMI, 98:3. 1964.

Figs. 7-8.

BASIDIOMATA (Fig. 7) arising from a rhizoid, ovoid to subglobose, smooth, covered with an incomplete network of shallow grooves, dirty white, 15 X 15-30 X 60 mm; in cross section there appear to be five separate tissues, 1) a thin white membranous peridium, 2) a rigid gelatinous peridium-like layer , 3) a thin white membranous layer enclosing the gleba, 4) fused glebal masses attached to the peridium by centripetally extended "sutures" and 5) a central gelatinous "filling". RHIZOMORPHS white, occasionally branched. ODOR when ripe of ethyl acetate (apples).

BASIDIOSPORES (Fig. 8) ellipsoidal to ovoid, smooth, hyaline, with a broad sterigmatal scar, (3.5) 4-6 (-7) X (3-) 3.5-4.5 (-5) µm.

MATERIAL EXAMINED: none. Description adapted from that of Dring (1964).

It is difficult to compare P. clathroidea with other described species of Protubera because of the lack of microscopic detail reported in its original diagnosis. The holotype was collected in sandy places in Togo. As noted above, the species also seems to occur in Pakistan. Aside from the habitat it is distinguished by its confluent peridial masses surrounding a central sterile gelatinous zone (called a columella by Dring) and by its broad basidiospores.

PROTUBERA JAMAICENSIS (Murrill) Zeller, Mycologia 40:644. 1948.
≡ Protophallus jamaicensis Murrill, Mycologia 2:25. 1910

Figs. 9-11.

BASIDIOMATA (Fig. 9) arising from a rhizomorph, spherical, smooth, viscid, avellaneous, becoming white at maturity, 20-40 mm in diameter; in cross section there appear to be three separate tissues, 1) a thin white compact peridium, 2) a gelatinous inner layer that forms a peridium-like tissue 1-1.5 mm thick and extends inward to the center, and 3) centripetally arranged glebal plates extending inward from the peridium almost to the center. RHIZOMORPHS arising from the substrate, white, unbranched, extending to the center of the basidiomata. ODOR lacking.

PERIDIUM compact, 200-280 µm thick, composed of rather densely interwoven hyaline hyphae in a gelatinous matrix. GELATINOUS AREAS composed of interwoven gelatinous hyphae. GLEBAL MASSES arising as ingrowths of the peridium, filamentous, extending nearly to the center of the basidioma, olivaceous to deep brown, giving rise to a tortuous hymenium of basidia internally. BASIDIA (Fig. 10) 8-spored, clavate to subcylindrical. BASIDIOSPORES (Fig. 11) ellipsoidal, smooth, with a broad basal apiculus, brown in mass, 3.1-4.4 (mean = 3.6 ± 0.25) X 1.3-1.9 (mean = 1.6 ± 0.11) µm, with mean D/d = 2.26 ± 0.223.

MATERIAL EXAMINED: JAMAICA: near Cinchona, in shaded soil rich in humus on the bank of the Clyde River, Murrill, 7.I.1909. HOLOTYPE (NY); "same general locality" as the holotype (Coker & Couch, 1928), on very rotten wood, Coker, 1900 (NY).

The above description was based upon the reports of Murrill (1910), Coker & Couch (1928) and Zeller (1939) and augmented by my own examination of the holotype and Coker's material from the same locality. A colored illustration made by a Miss Taylor, who was studying at Cinchona at the time, is contained in the holotype packet and was also used. A second illustration, now torn in two, illustrates a cross sectional view of a basidioma (redrawn in Fig. 9) and of one glebal mass. It is not clear whether this was done by Miss Taylor or Dr. Murrill. The herbarium material at the New York Botanical Garden is not in good condition: the holotype seems to be nothing more than shell-like peridial fragments devoid of gleba or spores and the Coker material is half of a basidioma dried down from liquid preservative. There is a permanent microscope slide mount of *P. jamaicensis* at NY that is not clearly from either of the two localities. Like the Coker collection, however, it came originally from the herbarium of S. M. Zeller and may be part of the material that Coker had collected and later sent to him. On the other hand, a note in the holotype packet states that part of the collection had been preserved in liquid and it may be that this is what Zeller had used for his slide. This slide is the only material on which 8-spored basidia can be seen clearly.

The elongated glebal plates and basidiospore dimensions suggest that it is close to *P. nipponica*: in fact, it is difficult to discover characters useful in separating the two species. The only feature that may serve this purpose is the peridium, which is described as viscid in P. jamaicensis. Coker & Couch (1928), however, make no mention of this character at all. Another feature that may prove diagnostic is the extension of the rhizomorph of P. jamaicensis well into the center of the basidioma in the manner of a columella: this does not seem to occur in P. nipponica.

PROTUBERA MARACUJA Möller in Schimper, Bot. Mittheil. aus den Tropen 7: 10. 1895.

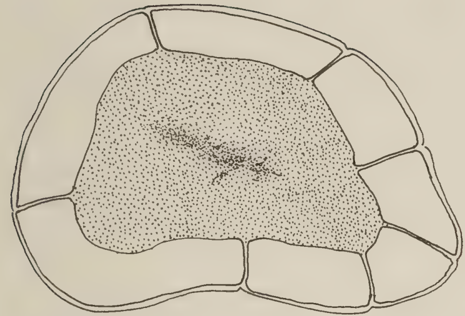
Figs. 12-15.

BASIDIOMATA (Fig. 12) arising from a rhizomorph, smooth, pale leather brown when young, becoming wrinkled and darker at maturity, up to 50 mm in diameter; in cross section there appear to be four separate tissues, 1) a thin brown compact peridium, 2) a rigid gelatinous peridium-like layer 2-3 mm thick, 3) a thin gelatinous "filling" and 4) centripetally arranged glebal plates growing inward from the peridium. RHIZOMORPHS extending into the humus, nearly white to pale reddish below, up to 3 mm in diameter, becoming branched and extending out into a network up to 1 meter long. ODOR of ripe passion fruit when mature.

OUTER PERIDIAL LAYER (Fig. 13) compact, 175-225 µm thick, appearing to be pseudoparenchymatous in cross section, orange-brown, with cells ca. 10-60 µm in diameter, with inner cells apparently enclosing large druse-like masses of irregular colorless crystals (Fig. 14). GELATINOUS AREAS composed of septate, interwoven, rather contorted and apparently clampless hyphae 1.8-3.7 µm in diameter, with hyphae less gelatinized in the area adjacent to the peridium and the glebal masses. GLEBAL MASSES arising as ingrowths from the peridial layer, filamentous, less gelatinized than the surrounding tissues, extending one-third to two-thirds of the way to the center, giving rise to a regular hymenium of basidia internally. BASIDIA 8-spored, short-sterigmate. BASIDIOSPORES (Fig. 15) ellipsoidal, smooth, with a broad basal apiculus, Brown (7E6-8) in mass, 2.9-3.8 (mean = 3.3 ± 0.20) X 1.4-2.0 (mean = 1.70 ± 0.13) µm, with mean D/d = 1.95 ± 0.174.

MATERIAL EXAMINED: BRAZIL, Santa Catarina, Blumenau,

Figs. 1-3. Protubera africana. Fig. 1. Basidioma, redrawn from colored illustration in holotype packet. Fig. 2. Basidia. Fig. 3. Basidiospores. Figs. 4-6. Protubera borealis. Fig. 4. Basidioma, redrawn from Kobayasi (1938). Fig. 5. Basidia. Fig. 6. Basidiospores. Figs. 7-8. Protubera clathroidea. Fig. 7. Basidioma, redrawn from Dring (1964). Fig. 8. Basidiospores, redrawn from Dring (1964). Figs. 9-11. Protubera jamaicensis. Fig. 9. Basidioma, redrawn from illustration in holotype packet. Fig. 10. Basidium, probably collapsed. Fig. 11. Basidiospores. The basidiomata are X 1; the remainder X 1500.



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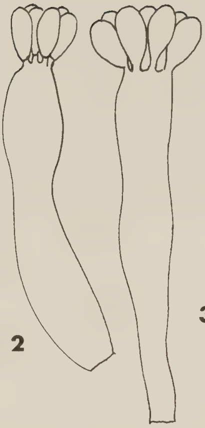

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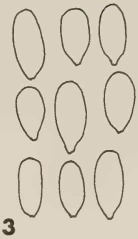

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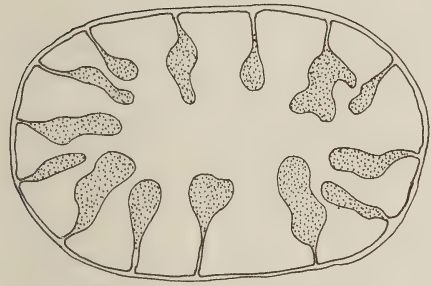

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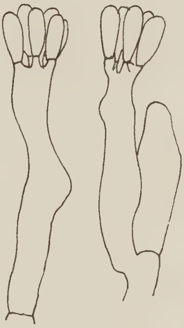

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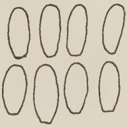

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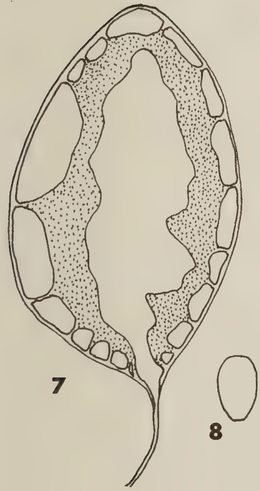

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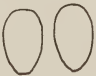

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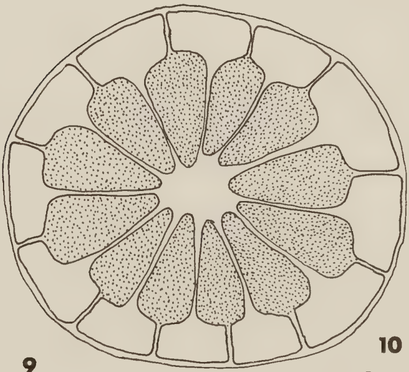

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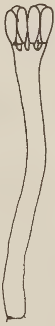

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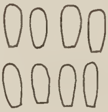

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in soil in woods, Möller, 1890. HOLOTYPE (B). ADDITIONAL MATERIAL EXAMINED BUT NOT INCLUDED IN THE ABOVE DESCRIPTION: BRAZIL: São Paulo: São Paulo, Reserva Biológica, Parque Estadual das Fontes do Ipiranga, Sales & Vital, 8.V.1961 (SP 62010); Milanez & Altimari, 27.V.1961 (SP 62033); Zago & Furtado, 23.XII.1960 (SP 62107); Guidicci, 7.VII.1965 (SP 83551); Serra da Cantareira, Picada das Jaboticabeiras, Zampieri, 13.I.1966 (SP 91082); Serra da Cantareira, Serviço Florestal do Estado, Hernandes, 13.I.1966 (SP 91083); Serra da Cantareira, Johnston, 13.I.1966 (SP 91084); Ubatuba, Estaçao Experimental do Instituto agronomico de Campinas, Hernandes, II.1966; Paranapiacaba, Estaçao Biológica do alto da Serra, Hernandes, II.1966; São Paulo, Reserva Biológica, Parque Estadual das Fontes do Ipiranga, Skvortzov, 14.VI.1967. All of the above are at the Instituto de Botanica, São Paulo (SP).

The above description may be somewhat narrow as it includes only Möller's and my observations on the type. Furtado and Dring (1967), however, presented a description of this species based on a number of additional collections from Brazil. In that paper Furtado and Dring stated that their material confirmed "in every respect" the description of Möller. However, Möller described his material as having brown basidiomata while those of Furtado and Dring were white or grayish. Since both authors seem to have observed numerous specimens it is unlikely that differences in age account for this variation. Möller's original material came from temperate forests in Santa Catarina while that of Furtado and Dring was from tropical rain forests further north; perhaps humidity or habitat has some effect on color. I have examined 10 of the specimens cited by Furtado and Dring (1967) and find that there is also a difference in spore size from the holotype. In P. maracuja the spores never exceeded 3.8 µm long while those of the Furtado and Dring material averaged 4.1 µm and could be as long as 5.1 um. Spore diameters of the two groups were approximately the same and thus the D/d ratios were 1.7-2.4 in the holotype and 1.9-2.8 in the Furtado and Dring collections. The report of 4-spored basidia in their material by Furtado and Dring seems to be in error; I found only basidia with 8 spores.

The most striking feature of P. maracuja is the presence of numerous masses of crystals in the inner peridial cells (Fig. 14). These are very large and easily seen with lower power microscope objectives. I have not observed these in any other species and believe that they may be diagnostic. In this respect it is interesting that all of the Furtado and Dring specimens examined also contained these crystals. Möller (1895) supposed these to be calcium oxalate but did not offer evidence other than to mention that they dissolved in HCl. The supposedly pseudoparenchymatous peridium in P. maracuja may also be diagnostic. All of the material of this species that I examined, including the "controversial" collections, had this feature. It is very difficult to revive this tissue and it is quite possible that it is not truly pseudoparenchymatous. However, that is the way it appears in herbarium specimens and it is quite unlike the clearly hyphal peridia of other species.

PROTUBERA NIPPONICA Y. Kobayasi in Nakai & Honda, Novae Fl. Japan. 2:25. 1938.
= Kobayasia nipponica (Kobayasi) Imai & Kawamura, Sci. Rep. Yokohama Nat. Univ., Sect. II, 7:5. 1958.

Figs. 16-18.

BASIDIOMATA (Fig. 16) arising from a rhizomorph, spherical to somewhat irregular in shape, somewhat wrinkled or cracked above, sulcate toward the base, white, 25-50 mm in diameter; in cross section there appear to be three separate tissues, 1) a thin compact peridium, 2) a rigid gelatinous peridium-like layer 1.0-1.5 mm thick, 3) centripetally arranged glebal plates extending inward from the peridium; the center is hollow. RHIZOMORPHS white, simple or branched. ODOR not reported.

PERIDIUM compact, 150-235 µm thick, composed of interwoven and occasionally clamped hyphae. GELATINOUS AREAS composed of loosely interwoven gelatinous hyphae 2-5 µm in diameter, very firm and rubbery near the peridium and the glebal plates and softer to almost watery elsewhere. GLEBAL MASSES arising as ingrowths of the peridium, filamentous, densely packed, extending nearly to the center of the basidiomata, giving rise to a regular hymenium of basidia internally. BASIDIA (Fig. 17) 8-spored, short-sterigmate, irregularly clavate to cylindrical or ventricose, clamped at base, 22-41 X 1.7-5.0 µm. Basidiospores (Fig. 18) narrowly ellipsoidal, smooth, with a broad basal apiculus, Olive to Olive brown (3-4EF4) in mass, 3.5-4.8 (mean = 4.0 ± 0.24) X 1.5-2.3 (mean = 1.8 ± 0.16) µm, with mean D/d = 2.23 ± 0.211.

MATERIAL EXAMINED: JAPAN: Tottori Pref., Tottori-City, Kokoge, In woods of Pinus densiflora, Nagasawa, 21.IX.1976 (TMI-4250); Shimane Pref., Ochi-gun, Mizuho-cho, in forest of Pinus densiflora, Maeda, 9.X.1980 (TMI-6925).

The holotype was collected on the ground in unspecified woods in Kunitati (a western suburb of Tokyo), Honshu, Japan (Kobayasi, 1938). Additional collections were described by Imai & Kawamura (1958) from Kubokawa-City, Kochi Pref., Shikoku and Shingi, Omi Prov. (in Shiga Pref.), Honshu, Japan. It has been very well illustrated by Kobayasi (1938), Imai & Kawamura (1958) and Imazeki & Hongo (1965).

As discussed above, the most difficult species to distinguish from P. nipponica is P. jamaicensis. The only other species of the genus reported from Japan is P. borealis, which has shorter glebal plates. Kobayasi also distinguished the two species on the basis of the hollow center of P. nipponica basidiomata and the fact that the glebal chambers of P. nipponica are green in liquid preservative while those of P. borealis are leather brown.

PROTUBERA SABULONENSIS Malloch, sp. nov.

Figs. 19-24.

Basidiomata ad obovoidea irregulariter tuberoidea, ad levis araeolata, ad basem frequenter sulcata, alba, 21-64 X 10-55 mm. Peridium 16-65 µm crassum, luteobrunneum, a hyphae intertextis compositum. Trama gelatinosa, firma, a hyphae gelatinosae intertextae composita. Gleba ad peridium in laminae irregularae centripetaliter radiata, 3-15 X 1-5 mm. Basidia octospora, ad subclavata cylindracea, 16-25 X 3.9-5.0 µm. Basidiosporae leniter obovoideae, laevae, ad basim truncatae, flavobrunneae, 3.8-5.0 X 1.0-2.6 µm.

HOLOTYPUS: CANADA: Nova Scotia, Sable Island, 600 m NW of West Light, in loci aranosi a Ammophila breviligulata associata, Malloch 30.9.82/4, 30 September 1982. In herbarium cryptogamicum University of Toronto conservata.

BASIDIOMATA (Figs. 19, 23-24) arising from a rhizomorph, obovoid to somewhat irregular in shape, smooth to finely cracked above, often coarsely sulcate below or grooved when in contact with grass culms, dry, rubbery in texture, initially white, with surface easily discoloring when touched to reveal colors near Grayish yellow to Olive brown (4CF4) to Yellow brown (5E5), with some tints of Brownish orange (7C4) in age, 21-64 mm high, 10-55 mm broad; in cross section there appear to be three separate tissues, 1) a compact white peridium, 2) a firm gelatinous tissue filling the bulk of the basidioma, and 3) centripetally arranged glebal plates extending in from the peridium. RHIZOMORPHS white, usually branched, with peridium and gelatinous matrices continuous with those of the basidiomata, not extending into the interior of the basidiomata, extending into the substrate. ODOR of

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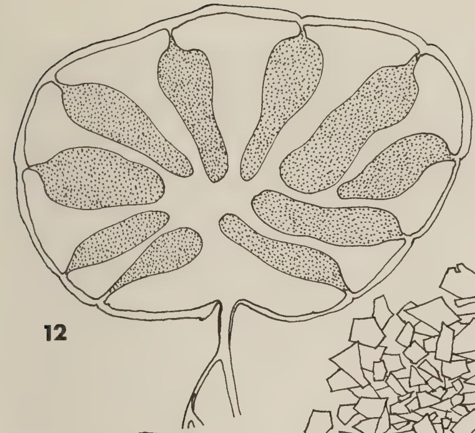
Figs. 12-15. Protubera maracuja. Fig. 12. Basidioma, redrawn from Möller (1895). Fig. 13. Cross section of peridium showing outer hyphal layer, "pseudoparenchymatous" layer and inner gelatinous matrix; note crystalline inclusions in the inner cells of the "pseudoparenchyma". Fig. 14. Crystalline inclusion from peridial cells. Fig. 15. Basidiospores, with upper group of 8 as attached to basidium. Figs. 16-18. Protubera nipponica. Fig. 16. Basidioma, redrawn from Kobayasi (1938). Fig. 17. Basidia. Fig. 18. Basidiospores. Figs. 19-22. Protubera sabulonensis. Fig. 19. Basidioma. Fig. 20. Cystidium-like element from gelatinous matrix. Fig. 21. Basidia. Fig. 22. Basidiospores. The basidiomata are X 1, Fig. 13 is X 75 and the remainder X 1500.



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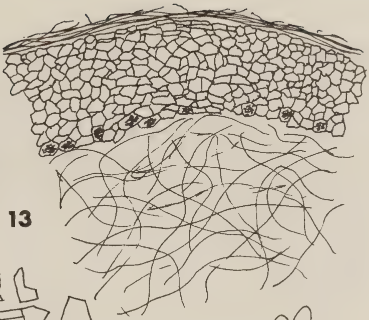

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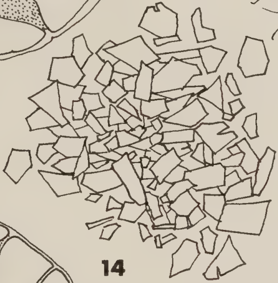

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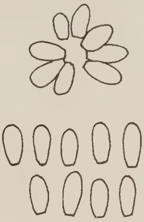

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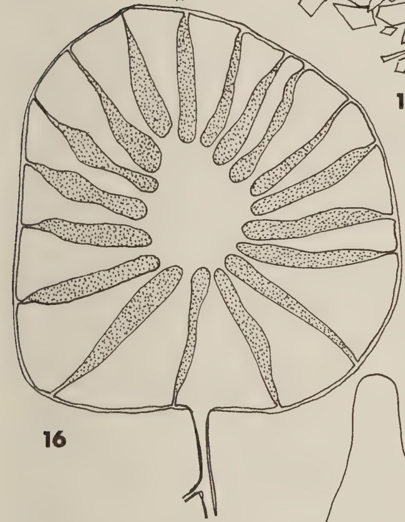

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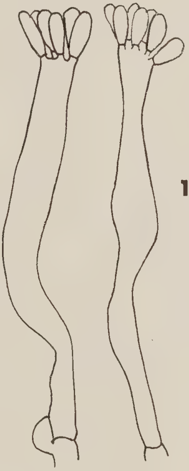

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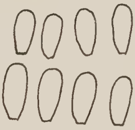

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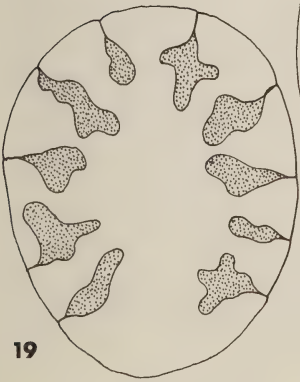

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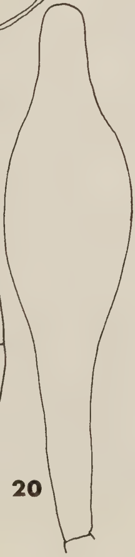

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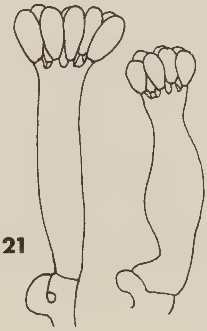

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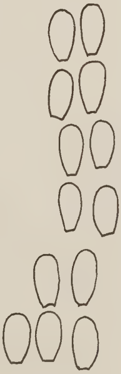

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overripe bananas when old.

PERIDIUM 16-65 µm thick, yellowish brown, composed of parallel to somewhat interwoven, apparently clampless hyphae 1.7-6.0 um in diameter, never enclosing crystalline masses. GELATINOUS AREAS hard and rather agar-like, nearly colorless to Yellowish grey (4B2) or Olive brown (4DE4) depending upon the stage of glebal maturity, composed of hyphae that are interwoven, very loosely arranged, clampless to occasionally clamped, hyaline, and 1.3-9.0 µm in diameter, often containing oleiferous hyphae that are sometimes swollen at the ends to form cystidium-like elements (Fig. 20). GLEBAL MASSES arising from "plates" of nearly parallel and hardly gelatinous hyphae similar to those of the peridium that extend inwardly at right angles to the surface, cerebriform, composed of labyrinthine cavities lined with basidia, rather irregular in size and shape but approximately 3-15 X 1-5 mm. BASIDIA (Fig. 21) 8-spored, borne in a parallel hymenium, ventricose to subclavate, clamped at base, with short sterigmata, 16-25 X 3.9-5.0 µm. BASIDIOSPORES (Fig. 22) narrowly obovoid, smooth, truncate at the broad sterigmatal scar, inamyloid, Grayish yellow (4BC3) to Yellowish brown (5EF6) in mass when fresh, 3.8-5.0 (mean = 4.4 ± 0.22) X 1.9 - 2.6 (mean = 2.3 ± 0.14) µm, with mean D/d = 1.94 ± 0.149.

MATERIAL EXAMINED: CANADA: Nova Scotia, Sable Island, 600 m NW of West Light (UTM Grid no. 21TTU567686), scattered to gregarious in sand in dense marram community on side of sand dune in association with *Ammophila breviligulata* Fern., *Lathyrus maritimus* (L.) Bigel. , and *Solidago semprevirens* L., *Malloch* 30.9.82/4, 30.IX.1982, HOLOTYPE (TRTC); 2.5 km E of West Light (UTM Grid no. 21TTU599687), in sand in small dune depression in dense marram community, *Malloch* 1.10.82/4, 1.X.1982 (TRTC).

P. sabulonensis is unique among species of *Protubera* in having a peridium less than 70 µm thick, a very dense and agar-like gelatinous matrix, quite broad basidiospores (mean D/d < 2.0) and habitat on oceanic sand dunes. It should not be confused easily with any other species.

The habitat of *P. sabulonensis* is unlike that of other species, with the possible exception of *P. clathroidea*. Both localities were behind the crests of large barrier sand dunes densely covered with *Ammophila breviligulata* ("Dense Marram Community" of Freedman, Catling & Lucas, 1982). Although well covered with grasses, these sites are all very dry and have no soil other than sand. All of the basidiomata were tightly adpressed to the base of the *Ammophila* culms and were deeply grooved along the area of

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Figs. 23-24. *Protubera sabulonensis*. Fig. 23. Basidiomata in sand beside culms of *Ammophila breviligulata*. Fig. 24. Basidiomata. Both X 1.25

23

24

contact. The rhizomorphs extended into the sand and appeared to be attached to dead and rotting culms and rhizomes. Of all species of Protubera, P. sabulonensis appears to be the most densely and uniformly gelatinous. It is likely that this extremely gelatinous nature of the basidiomata protects them against drying in the very xeric sites they occupy.

Most other species of Protubera occur in humus in forests; however, there is no indication that they are ectomycorrhizal. I know of no confirmed records of ectomycorrhiza formation by members of the Phallales. In addition, the occurrence of species of Protubera is frequently in association with trees known to form only vesicular-arbuscular mycorrhizae, such as Cryptomeria japonica. The roots of Ammophila breviligulata in the communities where P. sabulonensis occurred were only weakly mycorrhizal, and this appeared to be brought about by the usual aseptate VAM fungi.

The relationship of species of Protubera to the Phallales has not been disputed since the first species was described. In spite of this little has been said about odors. Most species of Protubera have been described as odorless. It is significant, though, that this is not entirely so: old basidiomata of P sabulonensis smell of overripe bananas, those of P. clathroidea smell of apples (Dring, 1964) while P. maracuja smells of ripe passion fruit. The fruity odor of P. maracuja was striking enough to Möller that he used it as the basis of his specific epithet; ie. maracujá, the local Brazilian name for passion fruit. It seems possible that these species attract and are dispersed by frugivorous insects. Dring (1964) reported that insects attacked older basidiomata of P. clathroidea and it is likely that this happens in other species but has passed unnoticed. The fact that some species have been reported as odorless may only be because the collectors smelled young basidiomata; if the fungus is attracting dispersers with these odors it will not likely do so before the spores are fully mature. It is tempting to consider Protubera species as dispersed by frugivorous insects while species of other Phallales attract feeders on less attractive substances. It is interesting in this regard, however, that Pilát & Usák (1958), in their discussion of Phallus impudicus L. ex Pers., state that Mutinus caninus (Huds.) Fr. has the same odor as P. impudicus and that while it is strong and offensive in the latter, M. caninus has been said by some mushroom collectors to have the odor of fruit. This suggests, at least, that the same substances may play a part in the odors of all Phallales.

KEY TO THE SPECIES OF PROTUBERA

There is much yet to be learned about the taxonomy of Protubera. Most collections have not been adequately studied in the fresh state and we thus lack information about elongation of glebal plates and changes in the gelatinous consistency of tramal tissues. Some of the species outlined above may be based on isolated stages in development and may be synonymous with one another. In spite of this uncertainty it is possible to make some decisions about taxonomic relationships among the species and to identify, cautiously, an unknown specimen. The following key is a step in this direction.

1. Peridium appearing to be pseudoparenchymatous in cross section, often enclosing druse-like crystalline masses in the innermost parts ... . *P. maracuja*
1. Peridium usually clearly composed of interwoven hyphal elements, not enclosing large crystalline masses 2

2. Glebal masses apparently confluent, not appearing as centripetally arranged ingrowths of the peridium 3
2. Glebal masses distinct and extending inward from the peridium as individual plates or masses 4

3. Glebal mass hollow; basidiospores broader than 3 µm .... *P. clathroidea*
3. Glebal mass solid, reticulate or poroid, resembling that of *Rhizopogon* species; basidiospores narrower than 3µm .. *P. africana*

4. Basidiospores 5-6 X 2.5-3.0 µm .... *P. brunnea*
4. Basidiospores smaller 5

5. Glebal masses elongated and extending nearly to the center of the basidiomata; gelatinous tissues soft to watery, sometimes absent at the center 6
5. Glebal masses rarely extending more than halfway toward the center of the basidiomata; gelatinous tissues firm and present at the center at spore maturity 7

6. Surface slightly viscid; rhizomorph extending well into the basidioma .... *P. jamaicensis*
6. Surface dry; rhizomorph not extending into the basidioma ..... *P. nipponica*

7. Peridium > 200 µm thick; gelatinous tissues firm but not hard and agar-like; mean basidiospore length/width ratio > 2.0 .... *P. borealis*
7. Peridium < 100 µm thick; gelatinous tissues hard and agar-like; mean basidiospore length/width ratio < 2.0 .... *P. sabulonensis*

ACKNOWLEDGEMENTS

I thank Dr. E. Nagasawa for sending me representative material of the two Japanese specimens and accompanying me to the collection locality of one of them and Dr. T. Sawa for translating some Japanese texts and clarifying for me the citations of Japanese localities. I am grateful to Dr. A. R. Lock of the Canadian Wildlife Service for arranging my visit to Sable Island and to Mr. R. B. Taylor for his generous help before, during and after that visit. The help of the curators of the New York Botanical Garden, the National Mycological Herbarium at Beltsville, Maryland, the Botanischer Garten und Botanisches Museum, Berlin-Dahlem and the Instituto de Botanica at Sao Paulo is gratefully acknowledged. This work was supported by an Operating Grant from the Natural Sciences and Engineering Research Council of Canada.

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NOTES ON CLAVARIADELPHUS. III. NEW AND NOTEWORTHY SPECIES FROM NORTH AMERICA[1]

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SUMMARY

Clavariadelphus americanus is proposed as an autonomous taxon based on *Clavariadelphus pistillaris* var. *americanus*. It is redescribed and a neotype specimen designated. Four new species from North America, *C. caespitosus*, *C. flavidus*, *C. occidentalis*, and *C. pallido-incarnatus* are described and illustrated.

Although *Clavariadelphus* Donk (1933) has been treated in several publications (Corner, 1950, 1970; Wells & Kempton, 1968; Smith, 1971; Petersen, 1972; Petersen et al., 1974), delimitation of infrageneric taxa in North America has proven difficult in many cases. A considerable part of the problem is the result of poor documentation of subtle variations in basidiocarp color, size, shape, growth habit, and micromorphological structures. Additionally, there has been a tendency for systematists to categorize collections of *Clavariadelphus* into three widely, often misapplied, epithets, *C. ligula* (Schaeff.: Fr.) Donk, *C. pistillaris* (L.: Fr.) Donk, and *C. truncatus* (Quél.) Donk. Lack of type specimens for certain taxa, including the three listed above, has further compounded the confusion surrounding the taxonomic and nomenclatural limits of infrageneric taxa in North America.

[1] This work represents a portion of a dissertation submitted to the Graduate School of The University of Tennessee, Knoxville, in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

During an examination of material collected by the author, and dried specimens from cooperating herbaria, some new taxa were recognized and are described herein. Additionally, C. americanus, recognized as an autonomous taxon based on C. pistillaris var. americanus Corner, is redescribed and a neotype specimen designated.

Microscopic features are described from sections revived in 95% ethanol and water, then mounted in 3% KOH, Melzer's reagent or cotton blue. Measurements were made in 3% KOH. Colors terms followed by alphanumeric designations are from Kornerup and Wanscher (1978), those from Ridgway (1912) are bracketed by quotation marks. Recipes for macrochemicals may be found in Marr and Stuntz (1973), Marr (1979), and Singer (1986), and abbreviations are as follows: KOH = 3% potassium hydroxide; $FeCl_3$ = 10% ferric chloride; EtOH = 95% ethanol; Melzer's = Melzer's reagent; PCR = p-cresol; PYR = pyrogallol; SYR = syringaldazine; TYR = 1-tyrosine; GUA = guaiac tincture; PHN = phenol; NH4OH = 10% ammonium hydroxide; NAP = 1-naphthol; ANO = aniline oil.

Abbreviations used in citation of basidiospore size are as follows: L_m = mean length; W_m = mean width; E = length/width ratio; E_m = mean of E. Herbarium acronyms are from Holmgren et al. (1981) except for the following individuals who lent specimens from their private herbaria: Wm. Bridge Cooke -- Herbarium of Wm. Bridge Cooke (= WBC); P. E. Kempton -- Wells and Kempton Herbarium (= WK); Clark L. Ovrebo -- Herbarium of Clark L. Ovrebo (= CLO).

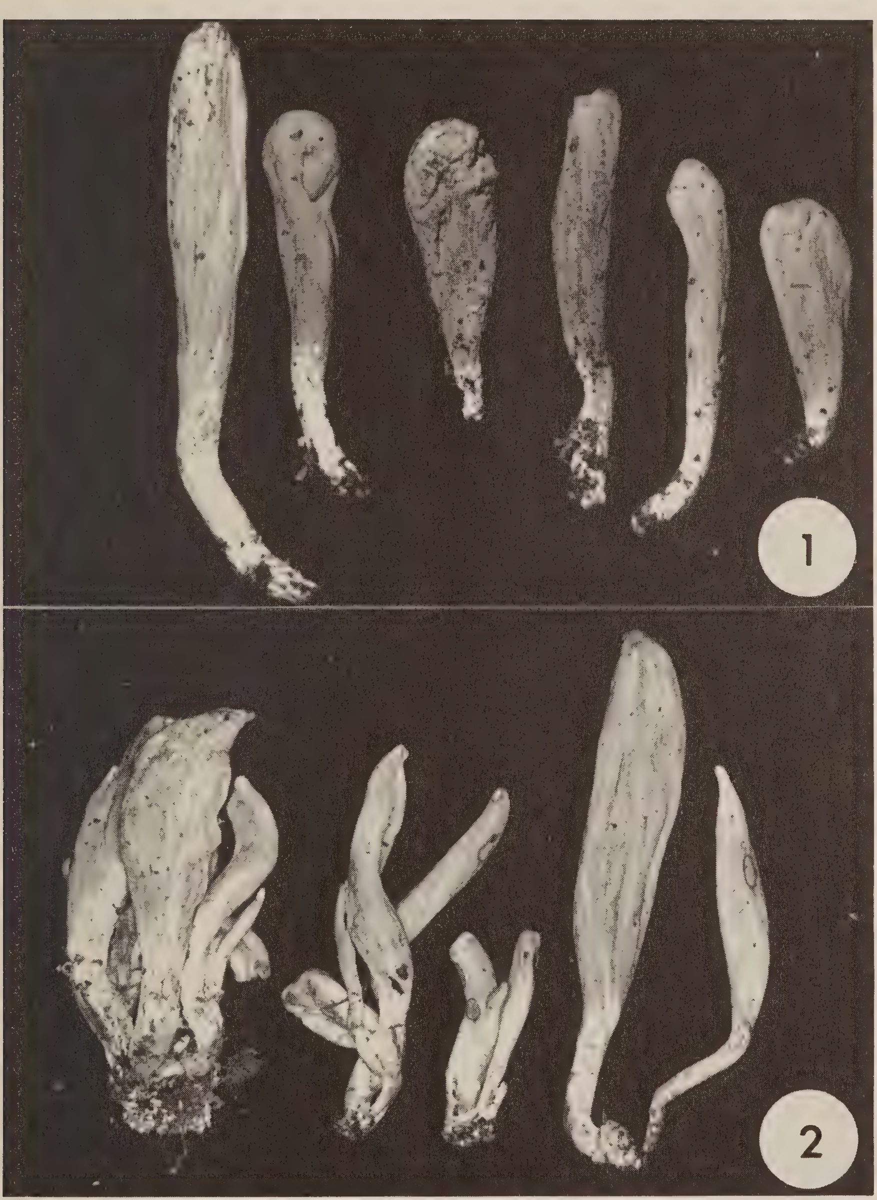
Clavariadelphus americanus (Corner) Methven, stat. nov.

Figs. 1,3-5

= Clavariadelphus pistillaris var. americanus Corner. 1950. Ann. Bot. Mem. 1: 692.

= Clavaria pistillaris var. americana (Corner) Leathers. 1955. The genus Clavaria Fries in Michigan. Ph.D. dissertation (ined.), University of Michigan, Ann Arbor. 344 pp.

NEOTYPE (des. mihi.): TENN: United States, Massachusetts, Berkshire Co., White Oaks Road, vicinity of Williamstown, 16 Aug 1986, legit A. S. Methven No. 4724 (TENN 47403).

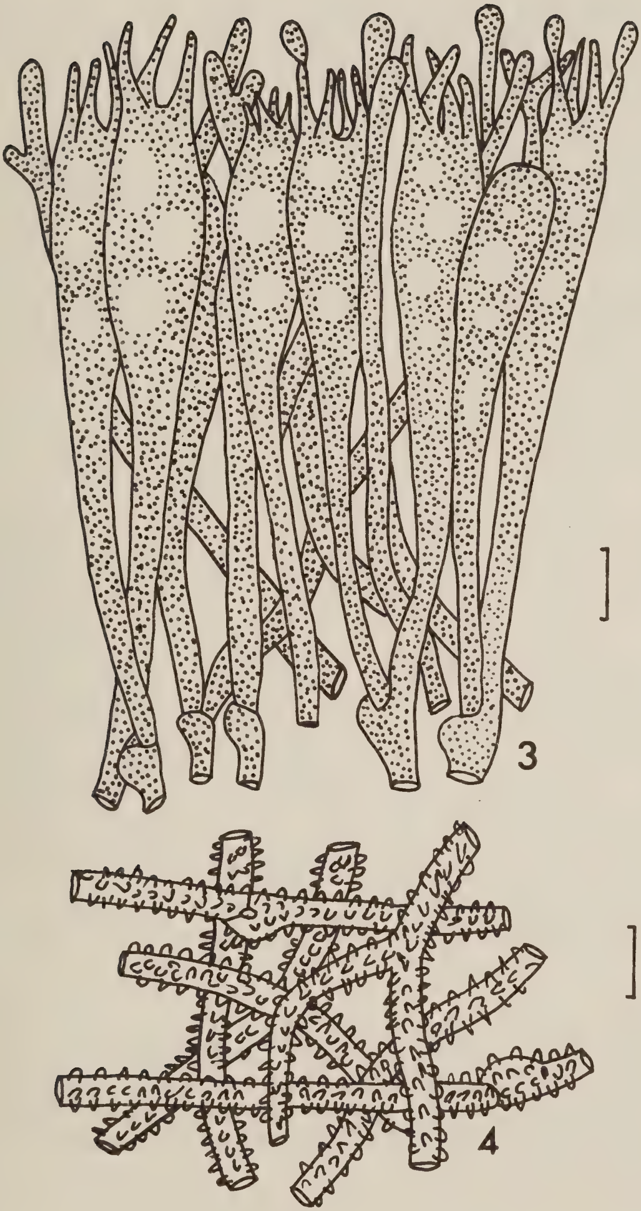


Figs. 1-2. 1. Basidiocarps of *Clavariadelphus americanus* (Methven 4715). x 1/2. 2. Basidiocarps of *Clavariadelphus caespitosus* (TENN 34744). x 3/4.

BASIDIOCARP 3-15 cm high, inserted 1-4 cm in the substrate, 3-12 mm diam basally, up to 30 mm diam apically, simple, initially subcylindric to narrowly clavate, enlarged upward in age, then clavate to broadly clavate; mycelial hyphae interwoven or aggregated into rhizomorphic strands up to 1 mm diam, off-white to pallid; base terete, smooth, pruinose, white or pallid where covered, otherwise yellowish white (4A2) to orange white (5A2), "light ochraceous-buff," "pale ochraceous-buff," "pale pinkish buff"; hymenium initially smooth, longitudinally rugose to rugulose in age, initially pale orange (5A3-2) to greyish orange (5B4-3), "light ochraceous-buff," "pale ochraceous-buff," "cartridge buff," "light buff," "pinkish buff," then brownish orange (6C6-4), "cinnamon-rufous," "cinnamon buff," "cinnamon," "orange-cinnamon," finally light brown (7D6-4) to brown (7E6-4), "mikado brown," "verona brown," "fawn color," "army brown"; apex obtuse to broadly rounded, smooth, more or less concolorous with the hymenium; surface staining slowly, irregularly brown (6E6-4, 7E6-4) to dark brown (7F6-4), "verona brown," "mikado brown," "mar's brown," "russet" where cut or bruised, staining more conspicuously downward; flesh initially solid, becoming soft and spongy upward as the apex enlarges, white to pallid, on exposure staining slowly, irregularly brown (6E6-4, 7E6-4) to dark brown (7F6-4), "verona brown," "russet," "mar's brown," "mikado brown". ODOR AND TASTE not distinctive.

MACROCHEMICAL REACTIONS: $FeCl_3$, $FeCl_3$ + EtOH, ANO, PYR, PHN, GUA, PCR, SYR = positive; KOH, NH_4OH, TYR = negative.

MYCELIAL HYPHAE 2.5-5 µm diam, branched, clamped, uninflated; walls thin or irregularly thickened to 1 µm, hyaline in KOH, refractive under phase contrast, smooth, echinate or echinulate; projections up to 1 µm high, hyaline, insoluble in KOH, refractive under phase contrast, acyanophilous; clamps uninflated or inflated (-8 µm), sometimes medallion or ampulliform; hyphal contents amorphous, hyaline in KOH. TRAMAL HYPHAE 4-12 µm diam, more or less parallel to longitudinally interwoven basally, more loosely interwoven upward, radially interwoven beneath the subhymenium, uninflated, inflated (-16 µm) or broadly undulate, branched, clamped; walls thin or irregularly thickened to 1 µm diam, hyaline in KOH, refractive under phase contrast, smooth; clamps uninflated or inflated (-16 µm), sometimes medallion or



Figs. 3-4. 3. Representative hymenium for taxa of Clavariadelphus: basidia and leptocystidia.
4. Representative mycelial hyphae for taxa of subg. Clavariadelphus sect. Clavariadelphus. Scale bars = 10 µm.

ampulliform; hyphal contents amorphous, hyaline in KOH. GLOEOPLEROUS HYPHAE 2.5-5 µm diam, arising from generative hyphae at clamp connections, scattered throughout the trama, more abundant downward, uninflated, inflated (-8 µm) or strangulated, branched, clamped; walls thin, hyaline in KOH, smooth; clamps uninflated or inflated (-8 µm), sometimes medallion or ampulliform; hyphal contents amorphous, subopalescent, yellow in KOH, refractive under phase contrast, cyanophilous. SUBHYMENIUM rudimentary; hyphae 2.5-5 µm diam, interwoven, branched, clamped, uninflated; walls thin, hyaline in KOH, smooth; clamps uninflated; hyphal contents amorphous, hyaline in KOH. HYMENIUM thickening, extending from near the base of the basidiocarp over the apex, composed of basidia and leptocystidia: LEPTOCYSTIDIA 55-80 x 2.5-5.5 µm, scattered among and scarcely projecting beyond the basidia, cylindric, subcylindric or strangulated, inflated apically at maturity, then narrowly clavate, at times apically or subapically branched, clamped; walls thin, hyaline in KOH, smooth; clamps uninflated; hyphal contents amorphous, pale yellow in KOH, acyanophilous: BASIDIA 60-110 x 8-12.5 µm, narrowly clavate to clavate, inflated apically at maturity, then broadly clavate, clamped; walls thin or irregularly thickened, hyaline in KOH, smooth; clamps uninflated; basidial contents multiguttulate and refringent to aguttulate and amorphous, pale yellow in KOH; sterigmata (2) -4, 7-9.5 µm long, broadest basally, narrowed to an obtuse apex, incurved. BASIDIOSPORES white in deposit, 8-12 x 4.5-6.5 µm (L_m = 9.6 µm; W_m = 5.2 µm; E = 1.6-2.1; E_m = 1.8); broadly ovate to amygdaliform; walls thin, hyaline in KOH, smooth; contents multiguttulate and refringent to aguttulate and amorphous, pale yellow in KOH; acyanophilous, inamyloid; hilar appendage oblique with an obtuse apex.

HABIT, HABITAT, AND DISTRIBUTION: Scattered to gregarious, less commonly in caespitose clusters; terrestrial; duff; mixed coniferous-deciduous forests in association with *Quercus* and *Pinus*, eastern North America: Illinois, Maine, Massachusetts, Michigan, Minnesota, New York, North Carolina, Nova Scotia, Ohio, Ontario, Pennsylvania, Tennessee, Vermont, and Wisconsin.

SPECIMENS EXAMINED: CANADA. NOVA SCOTIA. Kings Co.: Kentville Research Station Ravine, 4 Aug 1973, Harrison No. 12137 (ut *Clavariadelphus pistillaris*) (MICH). Colchester Co.: Upper Brookside, 27 Aug 1931, Smith No. 1417 (ut *Clavaria pistillaris*); Folleigh Lake, 29 Aug 1931, Wehmeyer No. 1417a, (ut *Clavaria pistillaris*). ONTARIO. Haliburton Co.: Wren Lake, 20 Sep 1984, Methven No. 3248 (TENN). Nipissing Co.: Algonquin Provincial Park, 21 Sept 1984, Methven Nos. 3256, 3257 (TENN). UNITED STATES. ILLINOIS. Jackson Co.: Lake Murpheysboro State Park, 7 Nov 1984, Methven No. 3587 (TENN). MAINE. Aroostook Co.: Near Madawaska Lake, 18 Aug 1956, Bigelow No. 4095 (ut *Clavariadelphus pistillaris*) (MICH). Hancock Co.: Acadia National Park, Mt. Desert Island, 1935, Morse *s*. *n*. (ut *Clavariadelphus pistillaris*) (TENN 31518). MASSACHUSETTS. Berkshire Co.: Oblong Road, vicinity North Adams, 15 Aug 1986, Methven No. 4715 (TENN); White Oaks Road, vicinity Williamstown, 16 Aug 1986, Methven No. 4724 (TENN 47403) [NEOTYPE]. MICHIGAN. Emmet Co.: Pellston Hills, 25 Aug 1956, Thiers No. 4394 (ut *Clavariadelphus pistillaris*) (MICH). Gratiot Co.: Ithaca, 15 Sep 1961, Potter No. 13146 (MICH). Jackson Co.: Clear Lake, 13 Aug 1960, Shaffer No. 2604 (ut *Clavariadelphus pistillaris*) (MICH). Marquette Co.: Canyon Lake Bay, 4 Sep 1970, Harrison No. 9614 (ut *Clavariadelphus pistillaris*) (MICH). Oakland Co.: Ormand Road, 12 Aug 1937, Smith No. 7012 (ut *Clavaria pistillaris*) (MICH; NCU); Haven Hill, Highland Recreation Area, 20 Sep 1972, Weber No. 3723 (ut *Clavariadelphus pistillaris*) (MICH); New Hudson, 26 Aug 1937, Smith No. 7302 (ut *Clavaria pistillaris*) (MICH; NCU); Haven Hill, 16 Sep 1961, Smith No. 64300 (ut *Clavariadelphus pistillaris*) (MICH); Horner Hill, 25 Sep 1975, Smith No. 86661 (ut *Clavariadelphus pistillaris* var. *americanus*) (MICH). Ostego Co.: Vanderbilt, Pigeon River, Red Bridge, 10 Aug 1969, Smith No. 77794 (ut *Clavariadelphus pistillaris*) (MICH). Presque Isle Co.: Little Presque Isle Point, 28 Aug 1978, Ovrebo No. 634 (CLO). Washtenaw Co.: Ann Arbor, Horner Woods, 1 Aug 1973, Smith No. 84324 (ut *Clavariadelphus pistillaris*) (MICH); South of Highland Lake, 2 Oct 1970, Weber No. 3768 (ut *Clavariadelphus pistillaris*) (MICH); Waterloo, Bush Road Trail, 2 Aug 1973, Nimke No. 401 (ut *Clavariadelphus pistillaris*) (MICH). MINNESOTA. Rice Co.: Wheeling Township, Nerstrand Woods State Park, 24 Jul 1962, Weaver No. 7-24-62-N-1 (ut *Clavariadelphus pistillaris* f. *americanus*) (MICH; TENN 33669). NEW YORK. Washington Co.: Vaughns, 11 Aug 1915, Burnham No. 68 (ut *Clavaria pistillaris*) (NCU); Vaughns, 2 Sep 1917, Burnham No. 139 (ut *Clavaria pistillaris*) (NCU). NORTH CAROLINA. Macon Co.: Highlands, 10 Sep 1971, Harrison No. 11093 (ut

Clavariadelphus pistillaris) (MICH); Horse Cove, Jul 1964, No. 31411 (ut Clavariadelphus pistillaris) (TENN); Cliffside Lake, 2 Sep 1986, Desjardin No. 4101 (TENN); Highlands, 30 Aug 1932, No. 9599 (ut Clavaria pistillaris) (NCU). Orange Co.: Vicinity of Ginghaul Castle, 22 Oct 1947, No. 14321 (ut Clavaria pistillaris) (NCU); Chapel Hill, Battle's Branch, near Indian Springs, 21 Oct 1915, No. 1913 (ut Clavaria unicolor) (NCU); Chapel Hill, Battle Park, 20-23 Sep 1945, No. 13933 (ut Clavaria unicolor) (NCU); Chapel Hill, Battle Park, 24 Sep 1945, No. 13920 (ut Clavaria pistillaris var. unicolor) (NCU); Chapel Hill, Battle Park, 26 Sep 1945, No. 13950 (ut Clavaria pistillaris var. unicolor) (NCU); Chapel Hill, Meeting of Waters, 26 Sep 1945, No. 13951 (ut Clavaria pistillaris var. unicolor) (NCU); Chapel Hill, Meeting of Waters, 28 Sep 1945, No. 13960, (ut Clavaria pistillaris var. unicolor) (NCU); Chapel Hill, Meeting of Waters, 3 Oct 1945, No. 13995 (ut Clavaria pistillaris var. unicolor) (NCU); Chapel Hill, Mason Farm, 25 Oct 1946, No. 14068 (ut Clavaria pistillaris) (NCU); Chapel Hill, New Hope Creek Farm, 24 Oct 1947, No. 14324 (ut Clavaria pistillaris) (NCU). Swain Co.: Almond, 21 Sep 1971, Harrison Nos. 11233, 11234, 11235 (ut Clavariadelphus pistillaris) (MICH). Transylvania Co.: Pisgah National Forest, White Pines Campground, 13 Sep 1966, No. 32337 (ut Clavariadelphus pistillaris) (TENN). OHIO. Hamilton Co.: Miami-Whitewater Forest Park, Timberlakes Area, 2 Oct 1965, Cooke No. 36192 (ut Clavariadelphus pistillaris) (WBC; TENN 32445). Pike Co.: Pike Lake State Park, 23 Sep 1973, Cooke No. 48742 (WBC; TENN 47398). PENNSYLVANIA. Chester Co.: West Chester, Sep-Oct, 1887, North American Flora, Second Series No. 1922b (ut Craterellus pistillaris) (PAD). TENNESSEE. Blount Co.: Nales Creek, 26 Sep 1959, No. 22939 (ut Clavaria pistillaris) (TENN). Knox Co.: Ball Camp Pike, 6 Oct 1934, No. 6542 (ut Clavaria pistillaris) (TENN); Ball Camp Pike, 9 Oct 1934, No. 6543 (ut Clavaria pistillaris) (TENN). VERMONT. Windham Co.: Grafton State Forest, 30 Aug 1961, Shaffer No. 3510 (ut Clavariadelphus pistillaris) (MICH). WISCONSIN. Dane Co.: Blue Mounds, Aug 1903, No. 162 (ut Clavaria pistillaris) (NCU).

Corner (1950) described C. pistillaris var. americanus from frondose wood in eastern North America. Although Corner (1950) published a Latin diagnosis for var. americanus he did not designate a type specimen having examined no North American specimens at the time.

Instead, Corner based his variety on previous literature reports of *C. pistillaris* in North America, noting that it differed "in colour, form, and small spores from the European species."

In an attempt to bring order to the taxa similar to *C. pistillaris* in North America, Wells and Kempton (1968) proposed *C. cokeri* based on "Coker's excellent notes, the good spore deposit, Miss Eaton's fine illustration (Coker, 1932 [sic], Pl. 23)" and Coker's specimen (No. R 27, NCU). Wells and Kempton (1968) did not include Corner's var. *americanus* in their preliminary study of *Clavariadelphus* in North America, concluding that var. *americanus* was "based on literature" and because "we have seen no specimens which could be referred to it." Corner (1970), in a critical rebuttal, noted that Wells and Kempton dismissed "Coker's contribution and discarded the idea of var. *americanus* because it was based on literature and because they had seen no specimens which could be referred to it." Corner (1970) went on to say that var. *americanus* was based "not on literature (? *belles lettres*) but on the scientific researches of Harper, Coker, and Wehmeyer by direct citation and of Burt and Doty by reference in my Table XXI (Monogr. p. 282)." In Corner's own words then, his protologue (Corner, 1950) for var. *americanus* was taken from literature and in no part from specimens he had examined. After examining the collections for which Corner (1950) cited spore measurements in Table XXI, I found them to be representative of several discrete taxa. Coker's specimen from Connecticut (No. R 27, NCU) is the holotype of *C. cokeri* Wells and Kempton, Wehmeyer's collections (Smith 1417, Wehmeyer 1417a, MICH) are *C. americanus*, Doty's specimens are *C. occidentalis*, two of Coker's collections cited from New York (Burnham 68, 71, NCU) are *C. americanus* and *C. truncatus*, respectively, and Coker's collections from North Carolina are *C. americanus* (Nos. 1913, 3793, NCU) and *C. unicolor* (No. 4770, NCU). It is little wonder, then, that Wells and Kempton were confused by Corner's concept of var. *americanus*.

Following an examination of specimens labeled as *C. pistillaris* from eastern North America I believe one element of Corner's conglomerate taxon is more accurately recognized as autonomous. In order to provide maximum taxonomic data, one of my collections has been selected as a neotype for this taxon. Although the basidiocarps of *C. americanus* are similar in coloration to those of *C. pistillaris*, they are generally not as robust, the flesh has a sweet or nondistinctive taste, the basidiospores are smaller (10.5-14 x 6-7.5 µm for *C. pistillaris*), and it grows in mixed deciduous-coniferous forests in association with *Pinus* and *Quercus*.

In eastern North America, *C. americanus* is most likely to be confused with *C. cokeri* and *C. flavidus*. *Clavariadelphus cokeri* is distinct in its caespitose to fasciculate growth habit in hemlock forests, pinkish buff to rose pink basidiocarps, which are at times branched apically, and longer, narrower basidiospores (L_m = 10.3 µm; W_m = 4.4 µm). *Clavariadelphus flavidus* occurs in mixed coniferous-deciduous forests, produces bright yellow to lemon yellow basidiocarps, flesh without a distinctive taste, and the smallest basidiospores in subg. *Clavariadelphus* (7-10.5 x 4.5-5.5 µm).

In cases where the apex of the basidiocarp has been damaged during development, and becomes more or less truncate or turbinate as a result, *C. americanus* might be confused with *C. unicolor* (Rav. apud Berk.) Corner, which is found in similar habitats. *Clavariadelphus unicolor* is distinct, however, by its violet-brown to lavender-brown basidiocarps which become truncate early in development, often appearing cantharelloid or craterelloid at maturity, and longer, narrower basidiospores (L_m = 10.3 µm; W_m = 5.0 µm). As long as several basidiocarps at different stages of development are available, there is little problem in segregating these two taxa.

Clavariadelphus caespitosus Methven, sp. nov.   Figs. 2, 6

Receptaculum ad 15 cm altum, apice 5-15 mm latum, simplex, fusiforme vel clavatum; apex subacutus, laevis vel rugosus; hymenium laeve vel rugosum, juventute cinnamomeum, maturitate ferrugineum vel castaneum; caro spongiosa, albida, brunnescens; odor et sapor nullus; sporae 8-11.5 x 4.5-6.5 µm (L_m = 9.8 µm; W_m = 5.6 µm; E = 1.7-1.9; E_m = 1.8); late ovatae vel amygdaliformes, laeves, albae; hyphae monomiticae, intertextae, fibulatae. Gregaria vel cespitosa ad terram in sylvis coniferis Americae borealis occidentalis.

HOLOTYPUS: TENN: United States, Idaho, Bonner Co., Upper Priest River, 21 Sep 1968, legit A. H. Smith s. n. (TENN 33983).

BASIDIOCARP 3-15 cm high, 3-15 (20) mm diam apically, simple, intially subcylindric, enlarged upward in age, then fusiform to clavate; base terete, pruinose, orange white (5A2, 6A2), "pale ochraceous salmon," "buff-pink," "seashell pink"; hymenium initially smooth, longitudinally rugose to rugulose in age, initially greyish red (7B3-2) to dull red (8C3-2), "cinnamon buff," "cinnamon," "japan rose," "vinaceous-buff," "light vinaceous-fawn," finally reddish brown (8D5-4), "mikado brown," "cacao brown," "fawn-color," "vinaceous-russet"; apex subacute to narrowly obtuse, remaining more or less pointed throughout development, smooth, concolorous with the hymenium; surface staining slowly, irregularly brown (6E6-4, 7E6-4) to dark brown (7F6-4), "verona brown," "mikado brown," "russet," "mar's brown" where cut or bruised, staining more conspicuously downward; flesh initially solid, becoming soft and spongy upward as the apex enlarges, white to pallid, on exposure staining slowly, irregularly brown (6E6-4, 7E6-4) to dark brown (7F6-4), "verona brown," "mikado brown," "russet," "mar's brown". ODOR not distinctive. TASTE not distinctive or slightly bitter.

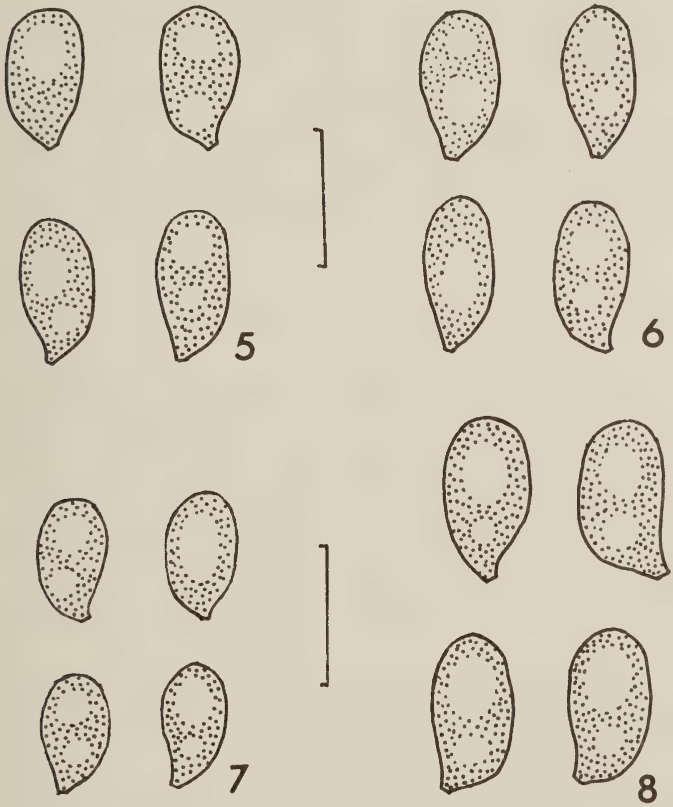
MACROCHEMICAL REACTIONS: $FeCl_3$, $FeCl_3$ + EtOH, NAP, ANO, PYR, PHN, GUA = positive; KOH = yellow to golden yellow; NH4OH = negative.

MYCELIAL HYPHAE 2.5-4 µm diam, branched, clamped, uninflated; walls thin or irregularly thickened to 1 µm, hyaline in KOH, refractive under phase contrast, smooth, echinate or echinulate; projections up to 1 µm high, hyaline, insoluble in KOH, refractive under phase contrast, acyanophilous; clamps uninflated or inflated (-12 µm), sometimes medallion or ampulliform; hyphal contents amorphous, hyaline in KOH. TRAMAL HYPHAE 3-12 µm diam, more or less parallel to longitudinally interwoven basally, more loosely interwoven upward, radially interwoven beneath the subhymenium, uninflated, inflated (-16 µm) or broadly undulate, branched, clamped; walls thin or irregularly thickened to 1 µm, hyaline in KOH, refractive under phase contrast, smooth; clamps uninflated or inflated (-16 µm), sometimes medallion or ampulliform; hyphal contents amorphous, hyaline in KOH. GLOEOPLEROUS HYPHAE 2.5-6.5 µm diam, arising from generative hyphae at clamp connections, scattered throughout the trama, more abundant downward, uninflated, inflated (-9.5 µm) or strangulated, branched, clamped; walls thin, hyaline in KOH, smooth; clamps uninflated or inflated (-12 µm), sometimes medallion or ampulliform; hyphal contents subopalescent, yellow in KOH, refractive under phase contrast, cyanophilous. SUBHYMENIUM rudimentary; hyphae 2.5-5 μm diam, interwoven, branched, clamped, uninflated; walls thin, hyaline in KOH, smooth; clamps uninflated; hyphal contents amorphous, hyaline in KOH. HYMENIUM thickening, extending from near the base of the basidiocarp over the apex, composed of basidia and leptocystidia: LEPTOCYSTIDIA 65-125 x 2.5-5 μm, scattered among and scarcely projecting beyond the basidia, cylindric, subcylindric or strangulated, inflated apically at maturity, then narrowly clavate, at times apically or subapically branched, clamped; walls thin, hyaline in KOH, smooth; clamps uninflated; contents amorphous, pale yellow in KOH, acyanophilous: BASIDIA 70-125 x 8-13.5 μm, narrowly clavate to clavate, inflated apically at maturity, then broadly clavate, clamped; walls thin or irregularly thickened, hyaline in KOH, smooth; clamps uninflated; basidial contents multiguttulate and refringent to aguttulate and amorphous, pale yellow in KOH; sterigmata (2) -4, 7-11 μm long, broadest basally, narrowed to an obtuse apex, incurved. BASIDIOSPORES white in deposit, 8-11.5 x 4.5-6.5 μm (L_m = 9.8 μm; W_m = 5.6 μm; E = 1.7-1.9; E_m = 1.8); broadly ovate to amygdaliform; walls thin, hyaline in KOH, smooth; contents multiguttulate and refringent to aguttulate and amorphous, pale yellow in KOH; acyanophilous, inamyloid; hilar appendage oblique with an obtuse apex.

HABIT, HABITAT, AND DISTRIBUTION: Gregarious, densely gregarious or caespitosus clusters; terrestrial; duff; coniferous or mixed coniferous-deciduous forests; California, Idaho, Oregon, and Washington.

SPECIMENS EXAMINED: UNITED STATES. CALIFORNIA. Del Norte Co.: Jedediah Smith Redwoods National Park, 11 Sep 1967, No. 33193 (ut *Clavariadelphus pistillaris*) (TENN). Humboldt Co.: Fickel Hill, 14 Sep 1984, Saylor No. 2184 (SFSU). Mendocino Co.: Jackson State Forest, 23 Nov 1985, Methven No. 4396 (TENN). Yuba Co.: Bullard's Bar Recreation Area, Schoolhouse Campground, 15 Dec 1983, Methven No. 2681 (TENN). IDAHO. Bonner Co.: Upper Priest River, 4 Oct 1970, No. 34685 (TENN); Priest Lake, 2 Oct 1966, No. 31954 (TENN); Priest Lake, 28 Sep 1968, Smith No. 76695 (MICH); Priest River, 19 Sep 1968, No. 33937 (TENN); Upper Priest River, 21 Sep 1968, Smith s. n. (TENN 33983) [HOLOTYPE]; Priest Lake, 29 Sep 1968, Smith

No. 76727 (MICH); Upper Priest River, 19 Sep 1968, Smith No. 76548 (MICH); Upper Priest River, 25 Sep 1968, Smith No. 76667 (MICH; TENN 47399). Kootenai Co.: Couer d'Alene, 7 Oct 1970, Nos. 34724, 34644 (TENN); Couer d'Alene National Forest, Deception Creek Experimental Forest, 22 Sep 1969, Smith no. 70662 (ut *Clavariadelphus ligulus*) (MICH). OREGON. Clackamas Co.: Mt Hood National Forest, 20 Oct 1984, Methven Nos. 3519, 3520 (TENN). WASHINGTON. Pierce Co.: Mt Rainier National Park, 15 Oct 1984, Methven No. 3540 (TENN).



Figs. 5–8. 5. Basidiospores of *Clavariadelphus americanus* (TENN 47403, Neotype). 6. Basidiospores of *Clavariadelphus caespitosus* (TENN 33983, Holotype). 7. Basidiospores of *Clavariadelphus flavidus* (TENN 47401, Holotype). 8. Basidiospores of *Clavariadelphus occidentalis* (TENN 47402, Holotype). Scale bars = 10 µm.

Clavariadelphus caespitosus is one of several taxa within sect. *Clavariadelphus* passing under the name *C. pistillaris* sensu lato. *Clavariadelphus caespitosus* is, however, quite distinct from that taxon by its slender, narrowly clavate, greyish red to dull red basidiocarps with subacute apices, caespitose growth habit in coniferous or mixed coniferous-deciduous forests, and smaller basidiospores (10.5-14 x 6-7.5 µm for *C. pistillaris*). In western North America *C. caespitosus* might be confused with *C. subfastigiatus* or *C. fasciculatus* Methven and Guzmán. *Clavariadelphus subfastigiatus* differs in its pallid flesh-color to light cinnamon basidiocarps with obtuse apices, forest green staining reaction with KOH, scattered to gregarious growth habit in coniferous forests, and smaller basidiospores (8-10.5 x 5-6 µm). *Clavariadelphus fasciculatus*, known at this writing only from central Mexico, is distinct by the strongly fasciculate growth habit of its basidiocarps, larger basidiospores (11-14 x 5-7 µm), and acerose- to acicular-shaped crystals encrusting the walls of the mycelial hyphae.

Clavariadelphus flavidus Methven, sp. nov. Fig. 7

Receptaculum 10-15 cm altum, apice 10-12 mm latum, simplex, cylindricum vel anguste clavatum; apex subacutus vel obtusus, laevis; hymenium laeve vel rugosum, laete aureum vel flavidum; caro spongiosa, albida, brunnescens; odor nullus, sapor amarus; sporae 7-10.5 x 4.5-5.5 µm (L_m = 8.4 µm; W_m = 5.0 µm; E = 1.4-2.0; E_m = 1.7); late ovatae vel amygdaliformes, laeves, albae; hyphae monomiticae, intertextae, fibulatae. Sparsa ad terram in sylvis frondosis-coniferis Americae borealis orientalis.

HOLOTYPUS: TENN: United States, Massachusetts, Berkshire Co., Williamstown Reservoir, 14 Aug 1986, legit A. S. Methven No. 4714 (TENN 47401).

BASIDIOCARP 10-15 cm high, 10-12 mm diam apically, simple, cylindric to narrowly clavate; mycelial hyphae interwoven or aggregated into rhizomorphic strands up to 1 mm diam, white to pallid; base terete, smooth, pruinose, off-white to pale cream; hymenium intially smooth, longitudinally rugulose in age, yellow (3A7-6) to yellowish orange (4A7-5), "apricot yellow," "light orange yellow," "light cadmium," "primuline yellow"; apex subacute to obtuse, smooth, concolorous with the hymenium; surface staining slowly, irregularly brown (6E5-4, 7E5-4) to dark brown (7F5-4), "rood's brown," "vandyke brown," "army brown," "natal brown," "bone brown" where cut or bruised, staining more conspicuously downward; flesh initially solid, becoming soft and spongy upward as the apex enlarges, white to pallid, on exposure staining slowly, irregularly brown (6E5-4, 7E5-4) to dark brown (7F5-4), "rood's brown," "vandyke brown," "army brown," "natal brown," "bone brown". ODOR not distinctive. TASTE bitter.

MACROCHEMICAL REACTIONS: $FeCl_3$, $FeCl_3$ + EtOH, PCR, PHN, PYR, ANO, GUA, SYR = positive; KOH, NH4OH, NAP, TYR = negative.

MYCELIAL HYPHAE 2.5-5 µm diam, branched, clamped, uninflated; walls thin or irregularly thickened to 1 µm, hyaline in KOH, refractive under phase contrast, smooth, echinate or echinulate; projections up to 0.5 µm high, hyaline, insoluble in KOH, acyanophilous; clamps uninflated or inflated (-12 µm), sometimes medallion or ampulliform; hyphal contents amorphous, hyaline in KOH. TRAMAL HYPHAE 3-9.5 µm diam, more or less parallel to longitudinally interwoven basally, more loosely interwoven upward, radially interwoven beneath the subhymenium, uninflated, inflated (-12 µm) or broadly undulate, branched, clamped; walls thin or irregularly thickened to 1 µm, hyaline in KOH, refractive under phase contrast, smooth; clamps uninflated or inflated (-16 µm), sometimes medallion or ampulliform; hyphal contents amorphous, hyaline in KOH. GLOEOPLEROUS HYPHAE 3-5 µm diam, arising from generative hyphae at clamp connections, scattered throughout the trama, more abundant downward, uninflated, inflated (-9.5 µm) or strangulated, branched, clamped; walls thin, hyaline in KOH, smooth; clamps uninflated or inflated (-8 µm), sometimes medallion or ampulliform; hyphal contents subopalescent, yellow in KOH, refractive under phase contrast, cyanophilous. SUBHYMENIUM rudimentary; hyphae 2.5-5 µm diam, interwoven, branched, clamped, uninflated; walls thin, hyaline in KOH, smooth; clamps uninflated; hyphal contents amorphous, hyaline in KOH. HYMENIUM thickening, extending from near the base of the basidiocarp over the apex, composed of basidia and leptocystidia: LEPTOCYSTIDIA 50-80 x 2.5-4 µm, scattered among and scarcely projecting beyond the basidia, cylindric, subcylindric or strangulated, inflated apically at maturity, then narrowly clavate, at times apically or subapically branched, clamped; walls thin, hyaline in KOH, smooth; clamps uninflated; hyphal contents amorphous, pale yellow in KOH, acyanophilous: BASIDIA 80-105 x 8-11 µm, narrowly clavate to clavate, inflated apically at maturity, then broadly clavate, clamped; walls thin or irregularly thickened, hyaline in KOH, smooth; clamps uninflated; basidial contents multiguttulate and refringent to aguttulate and amorphous, pale yellow in KOH; sterigmata (1,2,3) -4, 8-11 µm long, broadest basally, narrowed to obtuse apex, incurved. BASIDIOSPORES white in deposit, 7-10.5 x 4.5-5.5 µm (L_m = 8.4 µm; W_m = 5.0 µm; E = 1.4-2.0; E_m = 1.7); broadly ovate to amygdaliform; walls thin, hyaline in KOH; contents multiguttulate and refringent to aguttulate and amorphous, pale yellow in KOH; acyanophilous, inamyloid; hilar appendage oblique with an obtuse apex.

HABIT, HABITAT, AND DISTRIBUTION: Solitary or scattered; terrestrial; duff; mixed deciduous-coniferous forests under *Larix*, *Picea*, *Betula*, *Populus*, *Tilia*, and *Pinus*; Massachusetts.

SPECIMENS EXAMINED: UNITED STATES. MASSACHUSETTS. Berkshire Co.: Williamstown Reservoir, 14 Aug 1986, Methven No. 4714 (TENN 47401) [HOLOTYPE].

The hymenium extending from near the base of the basidiocarp over the apex, mycelial hyphae in which the walls are echinate or echinulate, and the broadly ovate to amygdaliform basidiospores with an Em < 2.0 indicate that *C. flavidus* is best placed in subg. *Clavariadelphus* sect. *Clavariadelphus*. In North America there are several taxa within sect. *Clavariadelphus* with which *C. flavidus* might be confused, including *C. occidentalis*, *C. pistillaris*, and *C. americanus*. Although *Clavariadelphus americanus* shares similar habitats with *C. flavidus* in mixed coniferous-deciduous forests in eastern North America, its larger, more robust, pale ochraceous basidiocarps which darken to cinnamon brown in age, and longer, broader basidiospores (L_m = 9.6 µm; W_m = 5.2 µm) are distinctive. *Clavariadelphus pistillaris* differs in its more robust, clavate, pale ochraceous basidiocarps which darken to cinnamon brown or fawn brown in age, larger basidiospores (10.5-14 x 6-7.5 µm), and habitat in deciduous forests in association with *Fagus*. *Clavariadelphus occidentalis*, which, as far as is known, is restricted to western North

America, exhibits more robust, pale yellow basidiocarps which darken to greyish orange in age, larger basidiospores (9-13.5 x 5.5-7 µm), and mild tasting flesh.

Among the European taxa included in sect. *Clavariadelphus*, *C. flavo-immaturus* Petersen and *C. xanthocephalus* Rahm & Schild are similiar to, yet distinct from, *C. flavidus*. *Clavariadelphus flavo-immaturus* features more robust, clavate basidiocarps, larger basidiospores (11-13.5 x 5.5-7 µm), and an orange staining reaction with KOH. *Clavariadelphus xanthocephalus* exhibits larger, more robust, turbinate or capitate basidiocarps, larger basidiospores (9.5-12 x 4.5-6 µm), and is not reactive with KOH.

In the field, *C. flavidus* might also be confused with *C. ligula* and *C. sachalinensis* (Imai) Corner, both of whose basidiocarps are infrequently bright yellow in color. These taxa can readily be segregated microscopically, however, by basidiospore size and shape. The basidiospores of *C. flavidus* are broadly ovate to amygdaliform in profile, with an Em $<$2.0, while those of *C. ligula* and *C. sachalinensis* are narrowly ellipsoid to boletoid in profile with an Em $>$ 3.0.

Clavariadelphus occidentalis Methven, sp. nov.

Figs. 8, 12

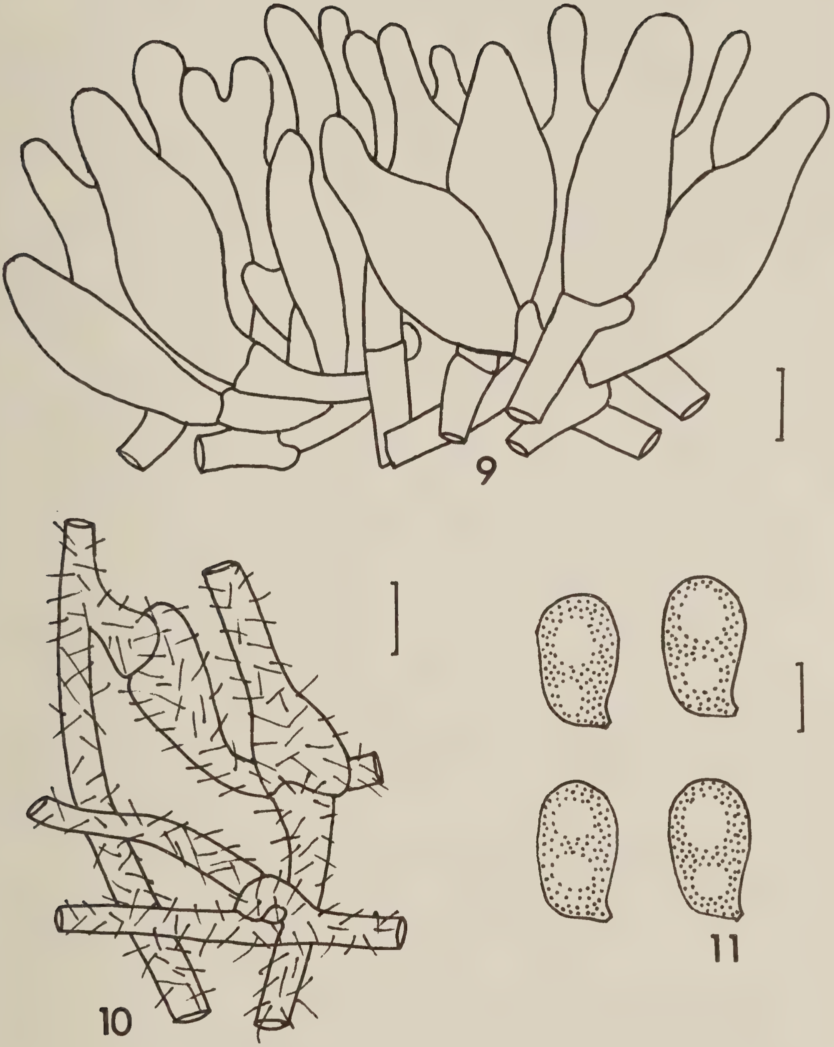
Receptaculum 10-20 cm altum, apice 10-30 mm latum, simplex, clavatum; apex obtusus, laevis dein rugosus; hymenium laeve dein rugosum, luteolum vel ochraceum; caro spongiosa, albida, brunnescens; odor et sapor nullus; sporae 9.5-13 x 5.5-7 µm (L_m = 11.1 µm; W_m = 6.3 µm; E = 1.4-2.0; E_m = 1.7); late ovatae vel amygdaliformes, laeves, albae; hyphae monomiticae, intertextae, fibulatae. Sparsa vel gregaria ad terram in sylvis frondosis-coniferis Americae borealis occidentalis.

HOLOTYPUS: TENN: United States, California, Yuba Co., Bullard's Bar Recreation Area, Schoolhouse Campground, 4 Jan 1987, legit A. S. Methven No. 5068 (TENN 47402).

BASIDIOCARP 5-20 cm high, 5-12 mm diam basally, 10-30 mm diam apically, simple, initially subcylindric to subfusiform, enlarged upward in age, then clavate to broadly clavate, finally irregularly, laterally compressed; mycelial hyphae interwoven or aggregated into rhizomorphic strands up to 1 mm diam, white to pallid; base terete, smooth, pruinose, white to pallid where covered, otherwise yellowish white (3A2) to pale yellow (4A3), "ivory yellow," "cartridge buff," "light buff," "pale ochraceous-buff"; hymenium initially smooth, longitudinally rugose to rugulose in age, initially light yellow (4A5-4) to orange white (5A2), "light buff," "pale ochraceous-buff," "pale ochraceous-salmon," "warm buff," "chamois," "light ochraceous-buff," "cream buff," finally light orange (5A4-3) to greyish orange (5B4-3, 6B4-3), "capucine buff," "pale yellow-orange," "cinnamon-buff," "pinkish cinnamon"; apex initially subacute, then obtuse or broadly rounded, smooth, concolorous with the hymenium; surface staining slowly, irregularly brown (6E6-4, 7E6-4) to dark brown (7F6-4), "verona brown," "mikado brown," "russet," "mar's brown" where cut or bruised, staining more conspicuously downward; flesh initially solid, becoming soft and spongy upward as the apex enlarges, white to pallid, on exposure staining slowly, irregularly brown (6E6-4, 7E6-4) to dark brown (7F6-4), "verona brown," "mikado brown," "russet," "mar's brown". ODOR AND TASTE not distinctive.

MACROCHEMICAL REACTIONS: FeCl$_3$, FeCl$_3$ + EtOH, ANO, PHN, PYR, PCR, GUA, SYR = positive; KOH, NH4OH, NAP, TYR = negative.

MYCELIAL HYPHAE 2.5-4 μm diam, branched, clamped, uninflated; walls thin or irregularly thickened to 1 μm, hyaline in KOH, refractive under phase contrast, smooth, echinate or echinulate; projections up to 1 μm high, hyaline, insoluble in KOH, refractive under phase contrast, acyanophilous; clamps uninflated or inflated (-9.5 μm), sometimes medallion or ampulliform; hyphal contents amorphous, hyaline in KOH. TRAMAL HYPHAE 4-12 μm diam, more or less parallel to longitudinally interwoven basally, more loosely interwoven upward, radially interwoven beneath the subhymenium, uninflated, inflated (-13.5 μm) or broadly undulate, branched, clamped; walls thin or irregularly thickened to 1 μm, hyaline in KOH, refractive under phase contrast, smooth; clamps uninflated or inflated (-16 μm), sometimes medallion or ampulliform; hyphal contents amorphous, hyaline in KOH. GLOEOPLEROUS HYPHAE 2.5-5 μm diam, arising from generative hyphae at clamp connections, scattered throughout the trama, more abundant downward, uninflated, inflated (-8 μm) or strangulated, branched, clamped; walls thin, hyaline in



Figs. 9-11. Micromorphological characters of Clavariadelphus pallido-incarnatus (TENN 47404, Holotype). 9. Apical pellis. 10. Mycelial hyphae. 11. Basidiospores. Scale bars = 10 µm for apical pellis and mycelial hyphae; 5 µm for basidiospores.

KOH, smooth; clamps uninflated or inflated (-12 µm), sometimes medallion or ampulliform; hyphal contents subopalescent, yellow in KOH, refractive under phase contrast, cyanophilous. SUBHYMENIUM rudimentary; hyphae 2.5-5 µm diam, interwoven, branched, clamped, uninflated; walls thin, hyaline in KOH, smooth; clamps uninflated; hyphal contents amorphous, hyaline in KOH. HYMENIUM thickening, extending from near the base of the basidiocarp over the apex, composed of basidia and leptocystidia: LEPTOCYSTIDIA 55-85 x 2.5-5 µm, scattered among and scarcely projecting beyond the basidia, cylindric, subcylindric or strangulated, inflated apically at maturity, then narrowly clavate, at times apically or subapically branched, clamped; walls thin, hyaline in KOH, smooth; clamps uninflated; hyphal contents amorphous, pale yellow in KOH, acyanophilous: BASIDIA 70-125 x 9.5-14 µm, narrowly clavate to clavate, inflated apically at maturity, then broadly clavate, clamped; walls thin or irregularly thickened, hyaline in KOH, smooth; clamps uninflated; basidial contents multiguttulate and refringent to aguttulate and amorphous, pale yellow in KOH; sterigmata (2) -4, 8-12 µm long, broadest basally, narrowed to an obtuse apex, incurved. BASIDIOSPORES white in deposit, 9.5-13 x 5.5-7 µm (L_m = 11.1 µm; W_m = 6.3 µm; E = 1.4-2.0; E_m = 1.7); broadly ovate to amygdaliform; walls thin, hyaline in KOH, smooth; contents multiguttulate and refringent to aguttulate and amorphous, pale yellow in KOH; acyanophilous, inamyloid; hilar appendage oblique with an obtuse apex.

HABIT, HABITAT, AND DISTRIBUTION: Scattered to gregarious, infrequently in caespitose clusters; terrestrial; duff; coniferous or mixed coniferous-deciduous forests: Alaska, Arizona, California, Idaho.

SPECIMENS EXAMINED: UNITED STATES. ALASKA. Gustavus, Rink River, Johnson Homestead, 6 Sep 1981, Cooke No. 59896 (WBC; TENN 47397); Fairbanks, Harding Lake Campground, 26 Aug 1965, Wells and Kempton Nos. 8/26/65-14, 8/26/65-15 (ut *Clavariadelphus pistillaris*) (WK 1984, 1985); Fairbanks, Livingood Road, 15 Aug 1964, Wells and Kempton No. 8/15/64-10 (ut *Clavariadelphus pistillaris*) (MICH); Glacier Bay National Monument, Water Pumping Station, 6 Sep 1979, Cooke No. 57176 (WBC; TENN 44854); Glacier Bay National Monument, Bartlett Cove, 3 Sep 1979, Cooke No. 57002 (WBC; TENN 44855); Glacier Bay National Monument, Water Pumping Station, 7 Sep 1979, Cooke No. 57231 (WBC; TENN 44852). ARIZONA. Graham Co.: Coronado National Forest, 29 Aug 1958, Lowe No. 9425 (TENN 32040). CALIFORNIA. Humboldt Co.: Willow Creek, no date, Largent No. 8158 (HSC). Marin Co.: Samuel P. Taylor State Park, 26 Dec 1985, Methven No. 4409 (TENN); Alpine Lake, 8 Dec 1984, Thiers No. 48393 (ut *Clavariadelphus pistillaris*) (SFSU). San Mateo Co.: San Francisco Watershed, 12 Jan 1986, Saylor No. 3041 (SFSU). Santa Barbara Co.: 17 Feb 1940, Rea No. 370 (ut *Clavaria pistillaris*) (MICH). Trinity Co.: Brizard Ranch, east of Salyer, Denning Road, 6 Dec 1982, Lanphere No. 12/6/62 (ut *Clavariadelphus pistillaris*) (MICH). Tuolumne Co.: Hwy 120, Moccasin Creek Recreation Area, 27 Jan 1979, Thiers No. 39368 (ut *Clavariadelphus pistillaris*) (SFSU). Yuba Co.: Bullard's Bar Recreation Area, Schoolhouse Campground, 15 Dec 1983, Methven No. 2682 (TENN); Bullard's Bar Recreation Area, Schoolhouse Campground, 4 Jan 1987, Methven No. 5068 (TENN 47402) [HOLOTYPE]; Bullard's Bar Recreation Area, Schoolhouse Campground, 4 Jan 1987, Methven No. 5069 (TENN). IDAHO. Bonner Co.: Priest Lake, 29 Sep 1984, Methven Nos. 3320, 3323 (TENN); Nordman, Granite Creek, 12 Oct 1956, Smith No. 54506 (ut *Clavariadelphus pistillaris*) (MICH); Upper Priest River, 21 Sep 1968, Smith No. 76553 (ut *Clavariadelphus pistillaris*) (MICH); Priest Lake, Binarch Creek, 22 Sep 1968, Smith No. 76574 (MICH); Priest Lake, 29 Sep 1968, Smith No. 76770 (ut *Clavariadelphus pistillaris*) (MICH); Priest Lake, Binarch Creek, 8 Oct 1968, Smith No. 77019 (MICH); Priest River, 21 Sep 1966, No. 32771 (ut *Clavariadelphus pistillaris*) (TENN); Priest River, 6 Oct 1966, No. 32241 (ut *Clavariadelphus pistillaris*) (TENN); Priest River, 21 Sep 1968, No. 33997 (TENN); Priest River, 22 Sep 1968, No. 34017 (TENN); Priest Lake, 24 Sep 1968, No. 34041 (TENN); Priest Lake, 23 Sep 1968, No. 34076 (ut *Clavariadelphus pistillaris*) (TENN); Priest River, 1 Oct 1968, No. 34261 (ut *Clavariadelphus pistillaris*) (TENN); Priest River, 7 Oct 1968, No. 34340 (TENN); Priest River 3 Oct 1968, No. 34708 (TENN). Kootenai Co.: Couer d'Alene, 30 Sep 1966, No. 32206 (ut *Clavariadelphus pistillaris*) (TENN); Couer d'Alene, 7 Oct 1970, No. 34737 (ut *Clavariadelphus pistillaris*) (TENN). Shoshone Co.: Devil's Elbow, Couer d'Alene River, 24 Oct 1972, Smith No. 83190 (ut *Clavariadelphus pistillaris*).

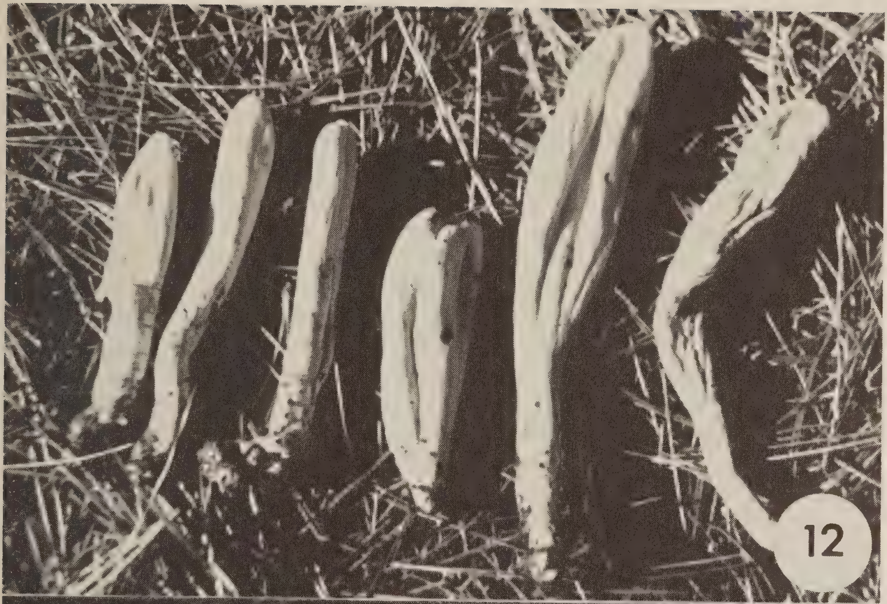
Clavariadelphus occidentalis is one of several taxa in sect. *Clavariadelphus* passing under the name *C. pistillaris* sensu lato. *Clavariadelphus occidentalis* differs from the latter by its light yellow basidiocarps which darken to greyish orange in age, habitat in coniferous or mixed coniferous-deciduous forests, and smaller basidiospores (10.5-14 x 6-7.5 µm for *C. pistillaris*). Other taxa within sect. *Clavariadelphus* with which *C. occidentalis* might be confused include *C. subfastigiatus*, *C. caespitosus*, and *C. fasciculatus*. *Clavariadelphus subfastigiatus* is distinct from *C. occidentalis* in its pallid flesh-color to light cinnamon basidiocarps, forest green staining reaction with KOH, and smaller basidiospores (8-10.5 x 5-6 µm). *Clavariadelphus caespitosus* differs from *C. occidentalis* by its slender, narrowly clavate, greyish red to dull red basidiocarps with subacute apices, caespitose growth habit, and smaller basidiospores (8-11 x 4.5-6.5 µm). *Clavariadelphus fasciculatus*, known at this writing only from Mexico, is unique in its strongly fasciculate growth habit, pinkish orange basidiocarps, larger basidiospores (11-14 x 5-7 µm), and acerose- to acicular-shaped crystals encrusting the walls of the mycelial hyphae.

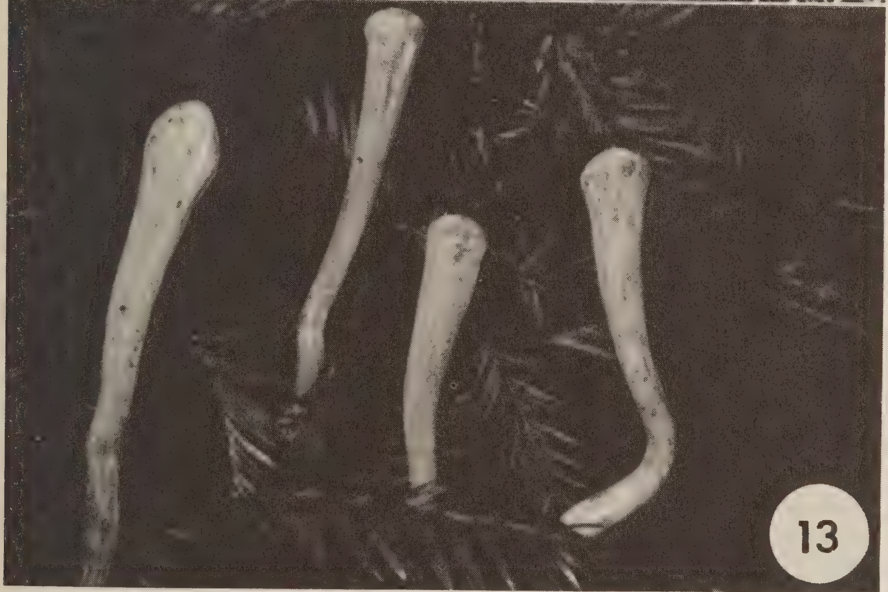
Small, immature basidiocarps of *C. occidentalis* might also be confused in the field with *C. ligula* and *C. sachalinensis*. These taxa can readily be segregated microscopically, however, by size and shape of basidiospores. Basidiospores of *C. occidentalis* are broadly ovate to amygdaliform in profile with an Em < 2.0, while those of *C. ligula* and *C. sachalinensis* are narrowly ellipsoid to boletoid in profile with an Em > 3.0.

Clavariadelphus pallido-incarnatus Methven, sp. nov.

Figs. 9-11, 13

Receptaculum 7-15 cm altum, apice 10-15 mm latum, simplex, clavatum vel turbinatum; apex obtusus dein truncatus, rugosus, sterilis; hymenium laeve dein rugosum, pallido-incarnatum, in KOH luteum; caro spongiosa, albida, brunnescens; odor nullus, sapor dulcis; sporae 9-11.5 x 6-7 µm (L_m = 10.3 µm; W_m = 6.3 µm; E = 1.4-1.8; E_m = 1.6); late ovatae vel amygdaliformes, laeves, albae; hyphae monomiticae, intertextae, fibulatae. Sparsa vel gregaria ad terram sub *Sequoia semperviренti*, *Picea sitchensi*, et *Alno* spp. in America boreali occidentali.





Figs. 12-13. 12. Basidiocarps of *Clavariadelphus occidentalis* (Methven 5067). x 1/2. 13. Basidiocarps of *Clavariadelphus pallido-incarnatus* (TENN 47404, Holotype). x 3/4.

HOLOTYPUS: TENN: United States, California, Humboldt Co., Prairie Creek Redwoods State Park, Davidson Road, 15 Oct 1986, legit A. S. Methven No. 5003 (TENN 47404).

BASIDIOCARP 7-15 cm high, 5-10 mm diam basally, 10-15 mm diam apically, simple, initially subcylindric, enlarged upward in age, then clavate to narrowly turbinate; mycelial hyphae interwoven or aggregated into rhizomorphic strands up to 1 mm diam, off-white to pallid; base terete, smooth, pruinose, yellowish white (4A2) to orange white (5A2), "pale ochraceous-buff," "light buff," "cartridge buff"; hymenium smooth, longitudinally rugose to rugulose in age, initially pale orange (5A3) to greyish orange (5B3), "seashell pink," "pale ochraceous-salmon," "pale pinkish cinnamon," finally flesh (6B3) to brownish orange (6C4-3), "light ochraceous-salmon," "light pinkish cinnamon," "light vinaceous-cinnamon"; apex initially obtuse to broadly rounded, more or less truncate in age, smooth, more or less concolorous with the hymenium; disc plane to depressed, not perforate or excavate; margin broadly rounded; surface staining slowly, irregularly brown (6D6-5, 6E7-6), "ochraceous-tawny," "buckthorn brown," "sayal brown," "tawny-olive" where cut or bruised, staining more conspicuously downward; flesh initially solid, becoming soft and spongy upward as the apex enlarges, white to pallid, on exposure staining slowly, irregularly brown (6E6-5, 7E6-5), "russet," "snuff brown," "rood's brown". ODOR not distinctive. TASTE slightly sweet.

MACROCHEMICAL REACTIONS: NAP, PYR, GUA, $FeCl_3$, $FeCl_3$ + EtOH, PCR, PHN, ANO, SYR = positive; KOH = yellow; NH4OH, TYR = negative.

MYCELIAL HYPHAE 2.5-4 µm diam, branched, clamped, uninflated; walls thin or irregularly thickened to 1 µm, hyaline in KOH, refractive under phase contrast, walls smooth, encrusted with acicular- to acerose-shaped crystals; crystals up to 8 x 1 µm diam, hyaline, insoluble in KOH, refractive under phase contrast, acyanophilous; clamps uninflated or inflated (-9.5 µm), sometimes medallion or ampulliform; hyphal contents amorphous, hyaline in KOH. TRAMAL HYPHAE 4-14.5 µm diam, more or less parallel to longitudinally interwoven basally, more loosely interwoven upward, radially interwoven beneath the subhymenium, uninflated, inflated (-19.5 µm) or broadly undulate, branched, clamped; walls thin or irregularly thickened to 1 µm, hyaline in KOH, refractive under phase contrast, smooth; clamps uninflated or inflated (-19.5 µm), sometimes medallion or ampulliform; hyphal contents amorphous, hyaline in KOH. GLOEOPLEROUS HYPHAE 5-9.5 µm diam, arising from generative hyphae at clamp connections, scattered throughout the trama, more abundant downward, uninflated or inflated (-12 µm), branched, clamped; walls thin, hyaline in KOH, smooth; clamps uninflated or inflated (-12 µm), sometimes medallion or ampulliform; hyphal contents subopalescent, yellow in KOH, refractive under phase contrast, cyanophilous. SUBHYMENIUM rudimentary; hyphae 2.5-5 µm diam, interwoven, branched, clamped, uninflated; walls thin, hyaline in KOH, smooth; clamps uninflated; hyphal contents amorphous, hyaline in KOH. HYMENIUM thickening, limited to the sides of the basidiocarp, composed of basidia and leptocystidia: LEPTOCYSTIDIA 60-85 x 2.5-6 µm, scattered among and scarcely projecting beyond the basidia, cylindric, subcylindric or strangulated, inflated apically at maturity, then narrowly clavate, at times apically or subapically branched, clamped; walls thin, hyaline in KOH, smooth; clamps uninflated; hyphal contents amorphous pale yellow in KOH, acyanophilous: BASIDIA 65-90 x 6-9.5 µm, narrowly clavate to clavate, inflated apically at maturity, then broadly clavate, clamped; walls thin, hyaline in KOH, smooth; clamps uninflated; basidial contents multiguttulate and refringent to aguttulate and amorphous, pale yellow in KOH; sterigmata (2) -4, 6-9.5 µm long, broadest basally, narrowed to an obtuse apex, incurved. APEX sterile: apical pellis a palisade of scattered basidia and sterile elements: STERILE ELEMENTS 20-40 x 5-10 µm, fusoid-ventricose to ventricose, clamped; walls thin, hyaline in KOH, smooth; clamps uninflated; contents amorphous, hyaline in KOH, smooth: BASIDIA as described above. BASIDIOSPORES white in deposit, 9-11.5 x 5.5-6-7 µm (L_m = 10.3 µm; W_m = 6.3 µm; E = 1.4-1.8; E_m = 1.6); broadly ovate to amygdaliform; walls thin, hyaline in KOH, smooth; contents multiguttulate and refringent to aguttulate and amorphous, pale yellow in KOH; acyanophilous, inamyloid; hilar appendage oblique with an obtuse apex.

HABIT, HABITAT, AND DISTRIBUTION: Scattered to gregarious; terrestrial; duff; under *Sequoia sempervirens* (Lamb.) Endl., *Picea sitchensis* (Bong.) Carr, and *Alnus* spp.; California.

SPECIMENS EXAMINED: UNITED STATES. CALIFORNIA. Humboldt Co.: Prairie Creek Redwoods State Park, Davidson Road, 15 Oct 1986, Methven No. 5003 (TENN 47404) [HOLOTYPE]; Prairie Creek Redwoods State Park, Rugg Grove, 8 Nov 1986, Saylor No. 3732 (SFSU).

The sterile, truncate basidiocarp apex, acicular- to acerose-shaped crystals encrusting the mycelial hyphae, and broadly ovate basidiospores place this taxon in subg. Clavariadelphus sect. Cantharellopsis, quite near C. truncatus. The pale coloration of the basidiocarps, lack of reactivity with KOH, and habitat in coastal coniferous forests of Sequoia sempervirens and Picea sitchensis distinguish C. pallido-incarnatus from C. truncatus.

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I am grateful for the assistance of Mrs. Ellen Thiers in preparation of the Latin diagnoses. The following people are recognized for assistance provided during my field work: Drs. J. Ammirati, T. Baroni, R. Bruce, J. Haines, R. Halling, D. Largent, R. H. Petersen, and H. D. Thiers, Mrs. Kit Scates-Barnhart, Mr. Dennis Desjardin, and Mr. Herb Saylor. I wish to thank the directors and curators of the herbaria listed under "specimens examined" who kindly provided materials for study. For helpful comments and suggestions I am indebted to Dr. R. H. Petersen.

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KEY TO THE SPECIES OF INOCYBE IN CALIFORNIA

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SUMMARY

A key to the species of Inocybe found in California is presented, based on a recent systematic study of the genus in southern California. The occurrence of nearly 60 species is indicated for the state, augmenting the 16 nominal species previously reported in the literature. Several species with type localities in California or the west coast of the U.S. were re-collected and determined for the first time since their original description. Distinct Inocybe floras appear in northern and southern California, associated with different forests, mixed conifer vs. live oak, respectively. Less than a quarter of the total species occur in both regions. A checklist is provided of nominal Inocybe species of California, based on published reports and herbaria records at SFSU and LAM.

The genus Inocybe has been poorly studied in most of North America, some conspicuous exceptions being areas near New York (Peck, 1872-1910), Michigan (Kauffman, 1920, 1924, 1925; A.H. Smith, 1939; Stuntz, 1954), Washington (Stuntz, 1940, 1965; A.H. Smith & Stuntz, 1950), Florida (Murrill, 1941, 1944, 1945), and Nova Scotia, Canada (Grund & Stuntz, 1968-1984). A recent systematic study of Inocybe in southern California (Nishida, 1987, and ms. in prep. for Contributions in Science, Natural History Museum of Los Angeles County) revealed that the genus is surprisingly well-represented in semi-arid southern California, in relatively moist, coastal woods of live oak (Quercus agrifolia). At least 26 smooth-spored species and 5 nodulose-spored species are reported from southern California. Voucher specimens are deposited in herbarium LAM (Natural History Museum of Los Angeles County, California). It is worth noting that most of these nodulose species occur in inland, montane conifer woods of

Pinus ponderosa, *P. jeffreyi*, and *Abies concolor*.

My study of the herbarium specimens at San Francisco State University (SFSU) indicates a northern California *Inocybe* flora of at least 26 smooth-spored species and 13 nodulose-spored species. Many of the *Inocybe* collections had been annotated by Daniel Stuntz in 1971, but many other collections had not been determined, nor examined microscopically and none had been reviewed in light of recent taxonomic revisions of the genus. Nearly 60 species of *Inocybe* are presently reported from California, in contrast to 16 nominal species previously reported in the literature (Earle, 1904; Peck, 1909; Kauffman, 1924; Murrill, 1916; A.H. Smith, 1939, 1941; Smith & Stuntz, 1950; Grund & Stuntz, 1970).

Based on collections in the herbarium at SFSU there is evidence of a contrasting *Inocybe* flora in northern California. This abundant collection represents the mycological activities of Harry D. Thiers and his students over many years in the mixed conifer and conifer-hardwood (*Pseudotuga menziesii*, *Abies grandis*, *Picea sitchensis*, *Quercus chrysolepis*, *Q. kelloggii*) forests of northern California. Although the two regions (northern and southern California) appear to have the same number of species of *Inocybe*, a closer examination shows that there are two distinct floras, with some overlapping of species. In general, nodulose species are more to be found associated with conifers. The northern California collection, mostly of the mixed conifer region, has 13 nodulose spored species, compared to 5 in southern California, where most of my collecting has been in the live oak woods. Nearly half (48%) of the total species occur only in northern California; less than a third (30%) occur only in southern California. Less than a quarter (23%) of the species are found in both regions. Among these latter are species of wide distribution in the world (*I. fraudans*, *I. geophylla*, *I. leptocystis*, *I. rimosa*, *I. mixtilis*, and *I . variabillima*).

California is an area of great floristic, topographic, and climatic diversity. Sampling of the live oak woods of the southern coast and the pine and fir woods of the northern coast has yielded nearly 60 species of *Inocybe*. Large areas, potentially rich in *Inocybe* species, remain unstudied, especially the stands of *Quercus kelloggii*, and *Q. chrysolepis* on the lower slopes of the Sierra Nevada range, and of *Q. douglasii* surrounding the central valley, as well as much of the conifer forest extending along the Sierra Nevadas.

Recent taxonomic studies by Thomas W. Kuyper, including a revision of European smooth-spored species (1986), have provided useful information on some particularly difficult "species complexes," as well as updating nomenclature. My own recent systematic study of the southern California species of *Inocybe* has resulted in some taxonomic revision. Both these works should be consulted for complete descriptions and synonymy of species, as well as Nishida (1988) for new species, reported in this key to species of *Inocybe* in California.

Key to Subgenera, Sections, and Subsections of Inocybe *

1. Pleurocystidia absent; cheilocystidia thin-walled, no crystals at apex; spores always smooth................2

    2. Cheilocystidia originating from the hymenophoral trama; basidia with necropigment; stipe usually shorter than diameter of pileus.. Subgen. Mallocybe

    2. Cheilocystidia originating as modified (sub)hymenial elements; basidia without necropigment; stipe usually longer than diameter of pileus...Subgen. Inosperma

        3. Pileus squamulose to squarrulose; context often reddening; basidia slender; odor often distinct.....................................Sect. Cervicolores
        3. Pileus radially rimose or rimulose, not squamulose or squarrulose; context reddening or not; basidia broader; odor mild or spermatic..Sect. Rimosae

1. Pleurocystidia present, almost always thick-walled and with crystals at apex; cheilocystidia of two kinds, pleurocystidioid and clavate to (sub)globose paracystidia; spores smooth, angular, or nodulose in outline.....................................Subgen. Inocybe

    4. Spores smooth in outline (subangular at times in *I. lacera*): ovate, ellipsoid, (sub)amygdaliform, less often (sub)reniform)..Sect. Inocybium

        5. Caulocystidia present over entire length of stipe (occasionally scarce in lower 1/3, or difficult to find or interpret) as thin- or thick-walled metuloids or thin-walled clavate, cylindrical cells of various sizes, or combination of these; cortina absent in young stage ....Subsect. Holoconiatae
        5. Caulocystidia present at apex of stipe only, occasionally rare or absent (sometimes with cystidioid terminal cells at the base, but not considered true cystidia); cortina often present in young specimens...Subsect. Acroconiatae

    4. Spores generally angular, or coarsely to definitely nodulose to stellate in outline...Sect. Inocybe

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* The infrageneric classification follows Kuyper (1986). I concur that this is a phylogenetically valid grouping of smooth-spored and nodulose-spored species.

6. Caulocystidia at apex of stipe only, or absent; cortina present in young stage..................................Subsect. Cortinatae
6. Caulocystidia over entire length (including lower 1/3); cortina absent in young stage...............................Subsect. Marginatae

Key to Species of Subgenus *Mallocybe*

Pleurocystidia absent; cheilocystidia thin-walled, no crystals at apex; spores always smooth; cheilocystidia originating from hymenophoral trama; basidia often with necropigment.

1. Small basidioma, pileus 10-25 mm, wooly-tomentose to coarsely scaly-squarrose, color fulvous to cinnamon-brown, context pallid to amber, purplish then brown in KOH; lamellae (sub)distant, margin pallid or concolored; cortina sparse; stipe sparsely to obviously fibrillose; cheilocystidia articulated, thin-walled, clavate; spores ovate to subreniform with distinct suprahilar depression, 10-11 x 5-6.5 µm; under *Salix* in wet places....................................*I. dulcamara*

1. Larger basidioma, pileus 20-60 mm, appressed-fibrillose but not scaly or wooly-tomentose, ochre to brownish ochre; lamellae pallid at first, often becoming concolorous; stipe fibrillose peronate with distinct, thick cortina; cheilocystidia thin-walled, clavate; spores elliptical to subreniform, 8-10 x 4.5-5.5 µm; under conifers...............................*I. agardhii*

Key to Species of Subgenus *Inosperma*

Pleurocystidia absent; cheilocystidia originating as modified hymenial elements; basidia without necropigment.

1. Pileus diffracted scaly on disc, brown, isabella to umber, squarrulose to squamulose in margin; stipe long (25-80 mm), pale brown at apex, darker at base, often with grey-green, blue-green to olivaceous blackish stains, surface coarsely squamulose; context reddening; odor sweetish, like *Pelargonium*, or fishy............ (Sect. *Cervicolores*, one species).....*I. calamistrata*

1. Pileus and stipe not scaly, squarrulose or squamulose... (Sect. *Rimosae*) 2
2. All parts of basidioma, including context, changing to vinaceous, pinkish red, or vinaceous brown; distinctive odor lacking; spores 10-12.5(-15) x 6-7(-7.5) µm..*I. adaequata*
2. Basidioma not changing as above.........................3
3. Pileus buff, ochraceous, yellow-brown to fulvous.....4
4. Stipe with blue-violet, gray-blue tints.............5
5. Spores (sub)reniform, > 6 µm broad.................

....................................*I. vinosistipitata*

5. Spores elliptical, < 6 µm broad; stipe gen. pale yellow, occ. violet...................*I. quietiodor*

4. Stipe white, pale yellow, becoming more yellow.......

6. Pileus often pallid overall at first, due to heavy covering of white velipellis (particularly in southern California husky, inodorous forms), in time becoming rimose and also yellow, yellow-brown to fulvous; odor absent, spermatic, or of fresh corn; spores 10-13 x 6-7 µm, (sub)reniform...*I. rimosa*

6. Pileus with conspicuous central white patch of velipellis, drying entire, rarely, in squamules; umbo very obtuse or absent; stipe wax colored, smooth, equal or swollen, never emarginate-bulbous; spores 9-10 x 5-5.5 µm, ellisoid, fewer subreniform; odor lacking or faintly rancid-mealy......*I. brunnescens*

3. Pileus brown, reddish brown, chestnut, russet, to umbrinous, lacking conspicuous velipellis; silky smooth; odor mild or faintly spermatic; spores 9-10 x 5-6 µm, mostly ellipsoid with obtuse apex...*I. fastigiella*

Key to Species of Subgenus *Inocybe*, Section *Inocybium*

Spores smooth (ovate, ellipsoid, subamygdaliform, subreniform; pleurocystidia present.

Key to Species of Subsection *Holoconiatae*

Caulocystidia found along entire length of stipe.

1. Entire basidioma reddening with age and/or on bruising, pure white at first; stipe base bulbous, sub-emarginate; odor spermatic; spores (10-)11-12.5(-15) x 6-7.5 µm, subamygdaliform to sublimoniform, apex subconical...*I. godeyi*

1. Basidioma not reddening with age.......................2

2. Stipe incarnate (some shade of reddish to orange, salmon, pinkish tan, reddish brown, reddish orange, or orange ochraceous), at least at the apex.............3

3. Odor of bitter almond.................................4

4. Odor of bitter almond in lamellae, spermatic in stipe; pileus ochraceous to ochraceous brown, radially fibrillose, sometimes becoming scaly; stipe orange ochraceous, not distinctly reddish; pleurocystidia cylindrical-clavate, to fusiform, moderately yellow in KOH..................*I. hirtella* var. *hirtella*

4. Odor weakly of almond, or else spicy as *Pelargonium*, frequently spermatic; pileus ochraceous brown to fulvous, tending to become squarrose-scaly around the disc; stipe often short, distinctly reddish brown at apex, or becoming purplish; pleurocystidia with bright yellow walls in KOH, fusiform to sublageniform ....*I. muricellata*

3. Without distinct odor of bitter almond..............5

5. Pileus bright colored (orange-brown, "rusty," tawny, fulvous)..6

6. Pileus often bicolorous, bright, tawny brown to red-brown on disc and ochraceous to honey in margin; stipe salmon-incarnate, context incarnate or pinkish orange; pileus and stipe often with tawny to orange fibrils; pleurocystidia extremely abundant, with very thick walls (4.5-5 µm); spores 9-11 x 5.5-6 µm ....*I. laetior*

6. Pileus unicolorous, bright orange-brown to fulvous orange; stipe pale orange-incarnate, context white; spores 8.5-9.5 x 5.0-5.5 µm..............*I. vaccina*

5. Pileus not brightly colored, definitely brown.......7

7. Pileus tending to become squarrose-scaly around disc, without obvious velipellis, ochraceous brown to fulvous; stipe distinctly reddish brown, sometimes becoming purplish; pleurocystidia bright yellow in KOH, thick-walled; odor spermatic, rarely, faintly spicy or of almond.................. ....*I. muricellata*

7. Pileus smooth, uniformly brown......................8

8. Pileus ochraceous brown, chestnut-brown, sometimes greyish on disc from velipellis; stipe reddish brown to orange ochraceous, with marginate bulb; pleurocystidia thin-walled, hyaline; spores rather small (7.5-9.5 x 4.5-5.5 µm), mostly ellipsoid..... ....*I. amblyspora*

8. Pileus dark reddish brown to mahogony brown, silky smooth, greasy appearing, velipellis absent or scanty; stipe incarnate, pinkish buff to fleshy ochracaceous, without bulbous base; pleurocystidia thick-walled; spores larger (8.5-10 [-12] x 5.5-6.5 µm)...............................*I. leiocephala*

2. Stipe white, pallid, or variously colored, sometimes distinctly darkening, but nowhere incarnate...........9

9. Spores generally >11 µm long (10-12 [-16] µm), ellipsoid to subamygdaliform; robust habit; pileus buff, tan, dull ochraceous to ochraceous brown, paler in center from thick velipellis; husky stipe (30-80 mm long), with subbulbous to emarginate bulbous base, often with grey-green stains; pleurocystidia variable, often subcapitate; thin-walled clavate caulocystidia sometimes present at base...............*I. bakeri*

9. Spores generally <11 µm long.........................10

10. Pileus light (cream, isabella brown, buff, tan, dull ochraceous, ochraceous brown); stipe not distinctly darkening..11

11. Pileus bright, yellow to golden with fulvous disc when fresh, becoming entirely orange brown when dry; velipellis absent; stipe pale yellow; pleurocystidia fusiform with very thick (4 µm), pale to moderately yellow wall; spores amygdaliform to sublimoniform 10-11 x 5.5-6 µm........... ....*I. chrysocephala*

11. Pileus pallid, not bright; stipe long, pallid...12

12. Habit robust (pil. 10-60 mm); pileus cream to isabelline, ochraceous, fibrillose-scaly at

disc; stipe long (40-80 x 4-10 mm), even to clavate at base; spores 8-10 x 5-6 µm, subamygdaliform; pleurocystidia lageniform to fusoid-ventricose, abundant...I. kauffmanii

12. Habit regular (pil. 38 mm); pileus white to buff silky-smooth; context light brown under pellis; acrid taste; spores 9-10 x 5-5.5 µm, elliptical to subreniform; pleurocystidia short, very rare, clavate to subfusiform, with extremely thick walls (4-5.5 µm), hyaline...I. menthi-gustans

10. Pileus definitely brown, sometimes appearing bicolorous; stipe darkening in lower half; odor of Pelargonium or of Amanita phalloides, or else spermatic.......................................13

13. Habit robust (pil. to 70 mm); stipe distinctly darkening to dark orange-brown, dark reddish brown or blackish brown; pileal disc light (yellowish brown), margin dark (cinnamon-brown to dark red-brown), uniformly brown when dry; spores ellipsoid, subamygdaliform, 8.5-9 x 5.0-6.0 µm..I. splendens

13. Habit slight (pil. to 55 mm); stipe not distinctly darkening, but discoloring with handling (tan to orange brown); disc vinaceous to chestnut-brown, margin reddish brown, uniformly russet when dry; spores 9-10 x 5.5-6.0 µm, amygdaliform, conical apex................................I. phaeoleuca

Key to Species of Subsection Acroconiatae

Caulocystidia found only in upper 1/3 to 1/2 of stipe.

1. Basidioma generally white to cream and remaining so or becoming tinted with other colors......................2

2. Slender habit (cap:stipe = <0.60); pileus 10-35 mm, silky-smooth to fibrillose, conical or convex, umbonate sometimes subviscid; odor spermatic..................3

3. Staining orange-red with time and/or damage, lubricous when wet, shiny..................I. whitei f. whitei

3. Not staining orange-red.............................4

4. Pileus with violet or lilac colors, especially in young specimens...........I. geophylla var. lilacina

4. Pileus without violet or lilac colors...............5

5. Remaining more or less silky white, or becoming buff in age..................I. geophylla var. geophylla

5. Not remaining white; disc of pileus fuscous, margin paler, and base of stipe also fuscous...I. fuscodisca

2. Stocky habit (cap:stipe = or >0.60), resembles Hebeloma pileus 20-50 mm, convex, exumbonate; dry or subviscid in wet weather; white to dingy buff, becoming matte buff to tan, never silky-fibrillose; odor lacking...I. insinuata

1. Basidioma colored from the first (ochre, yellow-brown, fulvous, reddish brown, umbrinous, etc.)................6

6. Basidioma having a distinct sweet, aromatic, or fruity odor...7

7. Pileal disc, and/or some part of the stipe with green (greyish green to dull olive-green), pileus often scaly; context whitish, not reddening; strong odor of "Peruvian balsam" or cinnamaldehyde..*I. corydalina* var. *corydalina*

7. Pileus smooth, color pale ochraceous, pale fulvous, or mixture of yellow, red, dark russet, umbrinous, vinaceous brown; context pallid, reddening upon exposure; stipe becoming brick red then vinaceous; strong odor, variously described as methyl cinnamate, "Peruvian balsam," or "matsutake".........*I. fraudans*

6. Basidioma lacking a distinct aromatic, sweet odor, or else with a spermatic odor...........................8

8. Violet or lilac shades in some or all parts: pileus, lamellae, stipe.......................................9

9. Pileus small, 10-35 mm, ochraceous brown, smooth, in age becoming diffracted-scaly in margin; lamellae briefly violaceous; stipe equal to subbulbous, often violaceous in lower portion; pleurocystidia fusoid-ventricose, hyaline; spores subamygdaliform, 7.5-10.5 x 4.5-5.5 µm......................*I. pusio*

9. Pileus large, 15-50 mm, dark brown, umbrinous to reddish brown, with violaceous tinges from underlying context, distinctly scaly to tomentose-squamulose; stipe equal with brown fibrillose punctae, streaks, or squamules, especially toward base; pleurocystidia slenderly fusiform, with thick, bright yellow walls; spores amygdaliform with subconical to papillate apex 8.5-10 x 5-5.5 µm..........*I. phaeocomis* var. *major*

8. Violet or lilac shades absent and pileus pallid, brightly colored or brown...........................10

10. Pileal colors pallid, ochraceous, to ochraceous brown or brightly colored, not definitely brown..11

11. Spores = or > 11 µm (10.5-13 x 5.5-6.0 µm) subamygdaliform; pleurocystidia broad, utriform to fusoid, thick walled, hyaline; pileus 25-55 mm, pale ochraceous to ochraceous brown, smooth, often with dirt or litter adhering; stipe white, husky (50-80 x 5-15 mm) with bulbous to emarginate base; differentiated caulocystidioid hairs sometimes found on base of stipe; odor lacking.....................*I. bakeri*

11. Spores <11 µm 12

12. Pleurocystidia long and narrow (60-90 µm), thick walled, pale to bright yellow; spores 7.5-9 x 4.5-5.0 µm, subamygdaliform; pileus isabella, greyish ochraceous to ochraceous brown; odor spermatic and farinaceous........................*I. subochracea*

12. Pleurocystidia short (40-60 µm), fusiform to utriform, with pale to bright yellow wall; spores 8.3-9 x 4.5-5.5 µm, subamygdaliform; pileus yellow, pale cream to ochraceous yellow ....*I. auricoma*

10. Pileus definitely brown; basidiocarp rarely with

violaceous colors 13

13. Basidioma with striking lamellar colors (bright orange to ochraceous tawny); also pileus orange to cinnamon at first, becoming cinnamon to "Sayal brown," context orange-cinnamon; stipe with heavy covering of cinnamon colored fibrils, context and surface cinnamon, becoming brownish, spores subamygdaliform; pleurocystidia fusoid-ventricose.... ....*I. cinnamomea*

13. Basidioma without striking lamellar color, but stipe may be incarnate (with pinkish, pinkish brown, reddish orange, reddish brown) or not....14

14. Stipe incarnate.................................15

15. Pleurocystidia uniquely thin-walled, without a double membrane, clavate to utriform with wavy margin, apex obtuse or subcapitate; spores subamygdaliform, 8-9 x 5-6 µm; pileus red-brown, "bay," sometimes fading to "tawny," at center or margin; odor faint, raphanoid to farinaceous... ....*I. leptocystis*

15. Pleurocystidia definitely thick-walled........16

16. Spores generally >11 µm.......................17

17. Spores elongate to slightly angular, 11-14 x 4.5-5.5 µm; pileus coarsely fibrillose, tomentose, squamulose to squarrose; stipe buff at apex, sometimes with pinkish tinge; brownish toward base, fibrillose..*I. lacera*

17. Spores never angular, but broad, 11.5-13.5 x 6-7 µm; pileus orange-brown to cinnamon - brown with conspicuous and persistent white patch of velipellis in center; smooth to slightly diffracted scaly on disc; stipe light brown with reddish to orange tinges, with submarginate bulbous base.............. ....*I. hemileuca*

16. Spores <11 µm 18

18. Pileus with disc distinctly darker than margin (disc umber to fuscous, sometimes ochraceous brown, outer whitish to cream); surface smooth to appressed-scaly to diffracted scaly; stipe densely fibrillose, reddish brown context and surface, caulocystidia at apex very rare; spores 9-10 x 5-5.5 µm; pleurocystidia subcylindrical to subfusiform, walls moderately thick (1.5-2 µm).............*I. phaeodisca*

18. Pileus unicolorous, dark brown, rufous to umbrinous, margin sometimes tawny olive; pleurocystidia ventricose, very thick-walled (3.5 µm); spores 10 x 5-5.5 µm, subamygdaliform; odor spermatic.................... ....*I. subdestricta*

14. Stipe not incarnate; pileus pale brown, ochraceous brown, fibrillose-squamulose especially over disc, often recurvately squamulose-squarrose; stipe white, becoming pale ochraceous or pale brownish; spores 8.5-9.5 x 5-6 µm, subamygdaliform; pleuro-

cystidia fusoid-ventricose, with thick (3.5 µm), pale to bright yellow wall; caulocystidia at stipe apex sometimes rare; odor spermatic-acidulous.......................................I. flocculosa

Key to Subgenus Inocybe, Section Inocybe

Spores angular, angular-nodulose, or obtusely to definitely nodulose to stellate in outline; pleurocystidia usually present.

Key to Species of Subsection Marginatae

Caulocystidia along entire stipe; stipe pruinose overall; cortina lacking or attached to base of stipe which is frequently bulbous.

1. Basidioma reddening and with pleasant, aromatic, fruity or sweet odor; pileus fulvous to yellowish brown; spores 7-9 x 5-6.5 µm, bluntly nodulose; pleurocystidia fusoid ventricose, thick walled..................I. bresadolae

1. Basidioma not reddening 2
 2. Stipe incarnate or becoming tinged with pink, orange, salmon...3
  3. Pileus bicolored, white to pale cream on disc, grey-vinaceous brown, or pale pinkish brown in margin; pellis smooth to minutely squamulose; spores 6.5-8 x 4.5-6 µm, with 7-9 nodules; pleurocystidia ventricose with thick wall (5-6.5 µm); odor spermatic...I. albodisca
  3. Pileus red-brown, cinnamon-brown, glabrous; stipe with marginate bulb, color gradually darkening; spores 9-11 x 5.5-8 µm, with 8-10 large, prominent nodules; pleurocystidia broadly ventricose to subglobose...I. oblectabilis
 2. Stipe not becoming incarnate...........................4
  4. Basidioma entirely white, remaining pallid...........5
   5. Pileus 25-50 mm smooth, greasy to subviscid at first, in time pale ochre-yellow; stipe base not distinctly bulbous; spores 8-10 x 5-6 µm, ellipsoid-oblong with 7-9 coarse nodules; pleurocystidia fusoid ventricose, thick walled (2.5-3 µm); strong odor of Cortinarius purpurascens ....I. olida
   5. Pileus 15-30 mm, dry, fibrillose, becoming obscurely scaly, white becoming dingy to ochraceous; stipe base bulbous to submarginate; spores 7-10 x 5-6 µm, polygonal, 4-9 nodules, or merely angular; pleurocystidia distinctly thick walled (4-5.5 µm), short (30-55 µm), fusoid to clavate...I. umbratica
  4. Basidioma not white, but variously colored...........6
   6. Stipe noticeably darkening or blackening............7
    7. Pileus 20-35 mm, straw-yellow to brownish yellow, often paler in margin or disc from velipellis, moist

to subviscid; stipe pale dingy straw color, darkening to gray or black on drying; spores 9-12 x 7-9 µm, with 9-12 large, prominent nodules; pleurocystidia lageniform, ventricose, with thick, bright yellow wall ....*I. xanthomelas*

7. Pileus 15-60 mm, pale brown to grayish brown, surface becoming appressed-fibrillose scaly; stipe pale yellowish, blackening on drying; spores 9-10 x 7-9 µm, oblong, with 8-12 large, prominent nodules; pleurocystidia slenderly ventricose with long neck, thick walled (3.5-5 µm), hyaline ....*I. nigrescens*

6. Stipe not noticeably darkening or blackening 8

8. Pileus straw, ochraceous brown to fulvous in margin, with yellow disc, 15-40 mm, silky to lubricous; lamellae grayish pallid; stipe pallid, densely pruinose, with marginate bulbous base; spores 8-10 x 5.5-6 µm, with 9-10 prominent nodules; pleurocystidia 40-55 µm long, broadly ventricose, very thick walled (2-5 µm), yellow...*I. mixtilis*

8. Pileus ochraceous brown to cinnamon-ochre, covered with greyish to grey-brown veil, smooth or greyish brown, scaly, 45-65 mm, umbonate, subviscid, dirt often adhering; stipe pallid, becoming yellowish brown; spores very large, 9-13 (-15) µm, scarcely nodulose, polygonal; pleurocystidia ventricose to clavate, thick walled (3 µm) ....*I. decipiens*

Key to Species of Subsection *Cortinatae*

Caulocystidia lacking on base of stipe; stipe not pruinose all over; cortina present in young specimens; stipe base bulbous or not.

1. Pleurocystidia lacking or extremely rare or difficult to find...2

2. Pileus brown, tomentose-scaly, to squarrulose-scaly...3

3. Pleurocystidia lacking; only thin-walled subglobose cheilocystidia; pileus dry, disc densely covered with minute squarrose scales, margin smooth, walnut-brown to umber; stipe floccose fibrillose to tomentose, concolorous; spores 10-12 x 8-9 µm ellipsoid, with 12-20 prominent subconical nodules; in damp woods, on rotten wood..............................*I. leptophylla*

3. Pleurocystidia short (25-45 µm), difficult to locate, ovate; pileus and stipe dark brown, densely squarrose to scaly overall, with pale zone below lamellae; spores 8-10 x 5.5-7 µm, with 8-10 small nodules; in conifer woods and on rotten wood ....*I. lanuginosa*

2. Pileus not strongly squarrulose-scaly; ochraceous, fulvous brown, reddish brown, fibrillose to finely appressed-fibrillose scaly; stipe pallid to tan, glabrous; spores 9-11.5 x 5.5-6.5 µm, oblong, notable by their extreme variability, from merely angular to angular-nodulose, to nodulose, but with low

nodules; pleurocystidia rare, short, 40-55 x 18- 30 µm, with distinctive, ovate or utriform shape, often with mucronate apex, wall not thick (1.5-2 µm) ....*I. variabillima*

1. Pleurocystidia present and obvious......................4

4. Pleurocystidia unique, truly thin-walled (reminiscent of *I. leptocystis*), 55-72 x 15-22 µm, clavate, ventricose, subcapitate; spores 9-10 x 6.5 µm, oblong, with 10-14 prominent nodules; pileus 10-50 mm, dark umber-brown to "snuff-brown" on margin, with large, erect scales on disc, squarrose on margin; stipe pallid, darkening to brownish in age, pinkish buff at apex, concolorous with pileus below ....*I. longicystis*

4. Pleurocystidia normal....................................5

5. Basidioma very small, pileus 5-15 mm, pale grey-brown, disc darker, greyish brown to chestnut-brown, with greyish white margin; spores 7-9 x 4.5-6 µm, obscurely nodulose; pleurocystidia with bright yellow wall..*I. petiginosa*

5. Pileus 20-40 mm, vinaceous brown to tawny olive on margin with cinnamon-buff disc, silky smooth at first from velipellis, becoming fibrillose, subrimose; stipe white to incarnate; spores unique, 5.5-8 x 13-19 µm, bullet shaped, with 1-5 large, obtuse nodules, or merely angular; pleurocystidia fusiform to clavate, thin-walled.............................*I. chelanenesis*

Checklist of Species of *Inocybe* in California

This is a checklist of nominal *Inocybe* species which either have appeared in the literature as occurring in California, or are associated with collections in the herbarium, SFSU. Some names, therefore, are synonyms or have been misapplied. Recent taxonomic studies of European inocybes by Kuyper (1986) and southern California inocybes by Nishida (1987, in prep.) should be consulted for discussions of species and complete synonymies. The columns to the right provide a quick reference to reports of *Inocybe* species in California. Headings are: (R), reports in literature; (N), collection from northern California in herbarium SFSU, only those studied and annotated by D.E. Stuntz and/or Nishida; (S), collection of southern California in LAM determined by Nishida; (P), associated plants: "Q" = *Quercus*, "C" = conifer. In columns, "T" indicates type collection made in California, "X" = present, "0" = absent.

Smooth-spored Species	R	N	S	P
I. adaequata (Britz.) Sacc.	0	X	X	Q
I. agardhii (Lund) Orton	0	X	0	C
I. agglutinata Peck = *I. whitei*	0	X	0	C
I. amblyspora Kühn.	0	0	X	Q
I. anomala Murr.	T	0	0	C
I. auricoma (Batsch) J. Lange	0	X	0	C

I. bakeri Peck	T	0	X	Q
I. brunnescens Earle	T	X	X	Q
non *I. brunnescens* Atk.				
I. bulbosa Peck	T	0	X	Q
(probably = *I. bakeri*)				
I. calamistrata (Fr.) Quel.	0	X	0	C
I. cincinnatula Kühn.	0	X	0	Q,C
= *I. phaeocomis* var. *major*				
I. cinnamomea A.H. Smith	T	0	0	C
I. corydalina Quel.	0	X	0	Q
I. dulcamara (Alb. et Schw.: Fr.) Kumm.	0	X	X	S
I. fastigiata (Fr.) Quel. = *I. rimosa*	X	X	X	Q
I. fastigiella Atk.	0	X	X	Q,C
I. flocculosa (Berk.) Sacc.	0	X	0	C
I. fraudans (Britz.) Sacc.	0	X	X	Q,C
I. fuscodisca (Pk.) Massee	X	X	0	Q,C
I. geophylla (Fr.:Fr.) Kummer	X	X	X	Q,C
I. geophylla var. *lilacina* (Pk.)Gill.	0	X	0	C
I. geophylla f. *perplexa* Kauff.	0	X	0	C
= *I. whitei*				
I. godeyi Gill.	0	0	X	Q
I. hirsuta var. *maxima*	X	X	0	C
= *I. calamistrata*				
I. hirtella Bres.	0	0	X	Q
I. insinuata Kauff.	T	X	X	Q,C
I. jurana sensu auct. = *I. adaequata*	0	X	X	Q,C
I. kauffmanii Smith	X	X	0	C
I. lacera (Fr.:Fr.) Kumm.	0	X	0	C
I. laetior Stz.	0	0	X	?
I. leiocephala Stz.	0	X	0	Q,C
I. leptocystis Atk.	0	X	X	Q
I. lilacina (Pk.) Kauff.	X	X	0	C
= *I. geophylla* var. *lilacina*				
I. muricellata Bres.	0	0	X	Q
I. olympiana (A.H. Smith)	0	X	0	C
I. phaeocomis var. *major* (S. Petersen) Kuyp.	0	X	0	C
I. phaeodisca Kühn.	0	X	0	Q
I. phaeoleuca Kühn.	0	0	X	Q
I. pudica Kühn. = *I. whitei*	0	X	0	Q,C
I. pusio P. Karst.	0	0	X	C
I. pyriodora sensu auct. = *I. fraudans*	X	X	X	Q
I. quietiodor M. Bon	0	0	X	C
I. retipes Atk.	0	X	0	C
I. rimosa (Bull.:Fr.) Kumm.	0	X	X	Q,C
I. serotina Peck	X	0	0	
(report is based upon a misapplied name)				
I. sororia Kauff. = *I. rimosa*	0	X	0	Q,C
I. splendens Heim	0	0	X	Q
I. subbrunnea Kühn. = *I. leiocephala*	0	X	0	C
I. subdestricta Kauff.	0	X	X	Q,C
I. subochracea (Pk.) Pk.	0	X	0	C
I. vaccina Kühn.	0	X	0	C
I. vinosistipitata Grnd & Stz.	0	0	X	Q
I. whitei (B. & Br.) Sacc.	0	X	X	Q,C
FHN #2487	0	0	X	Q
FHN #3976	0	0	X	Q

FHN #498	0	X	X	C
Nodulose-spored Species	R	N	S	P
I. acystidiosa Kauff. = = *I. variabillima*	T	0	0	C
I. albodisca Peck	0	X	0	Q,C
I. bresadolae Mass.	0	X	0	C
I. californica Kauff.	T	0	0	C
I. chelanensis Stz.	0	X	0	C
I. decipiens Bres.	0	X	X	Q,C
I. decipientoides Peck = *I. variabillima*	0	X	0	C
I. fallax Peck	0	X	0	C
I. lanuginosa (Fr.) Kummer	0	X	0	C
I. leptophylla Atk.	0	X	0	A
I. longicystis Atk.	0	X	0	C
I. mixtilis (Britz.) Sacc.	0	X	X	Q,C
I. nigrescens Atk.	0	X	0	C
I. oblectabilis Britz.	0	0	X	C
I. olida Maire	0	0	X	Q,C
I. petiginosa (Fr.) Gill.	0	X	0	C
I. umbratica Quel.	0	X	0	C
I. variabillima Speg.	0	X	X	Q,C
I. xanthomelas Bours. & Kühn.	0	X	0	C

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FOLIICOLOUS FUNGI 8: CAPNODIUM IN CALIFORNIA*

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One species of Capnodium occurs in California, which is redescribed with darkly pigmented and transverse to muriform septate ascospores. Capnodium dematum (V. M. Miller & Bonar) Reynolds nov. comb. is culturally found, as predicted in the literature, to have Phaeoxyphiella fisheri Batista in Batista & Ciferri as its anamorph. Other California fungi identified, misdescribed, and misidentified as Capnodium are annotated.

The systematic stability of the genus Capnodium sensu lato is representative of other ascomycete genera in which the sexual state has been historically presumed to be associated with one or more conidium-producing states. The first concept of the genus followed the spore morphology system of P. A. Saccardo and attributed darkly pigmented, muriform ascospores to the teleomorph and usually hyaline, unicellular or dark muriform pycnidial characters to deuteromycetes presumed as the anamorphs. Taxonomy of the California fungi called Capnodium is a microcosm of mycological progress from a Saccardian view of taxa delimitation based on character categorization to one of the "whole fungus" based on predictable patterns of biologically linked teleomorphs and anamorphs.

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* The previous paper in this series was published in Mycotaxon 27:377-403.

Attention was first drawn to California capnodiaceous fungi in the San Francisco Bay area by Cooke and Harkness (1881, 1884) in their series on California fungi. J. B. Ellis and B. M. Everhart (1893-1899) included W. C. Blasdale, A. J. McClatchie and W. H. Harkness collections from the area in their exsiccati series, Fungi Columbiani. Miller and Bonar (1941) described new species and misidentified several collections from similar material from the same area. Batista and Ciferri (1963a, 1963b) incorporated these and other specimens in their monographic revision of the genus and its supposed anamorphs. Records of sooty molds have been made in other areas of California (Farlow, 1876; Millspaugh and Nuttall, 1923; Reynolds, 1987).

CALIFORNIA CAPNODIUM

1. _Capnodium dematum_ (V. M. Miller & Bonar) Reynolds nov. comb. Miller and Bonar 1941:411.
   =_Phaeosaccardinula dematum_ V. M. Miller & Bonar. Miller and Bonar 1941:411-412.
   =_Capnodium baccharidis_ Batista & Ciferri. Batista and Ciferri 1963a:90-92.
   =_Leptocapnodium krameri_ Batista & Ciferri. Batista and Ciferri, 1963a:123-125. Pro parte, Reynolds, 1971a:151-152.

Type: USA, California, San Mateo County, Moss Beach, H. E. Parks 2139, 17 April 1924, on _Baccharis pilularis_, UC617322.

ASCOSPORES 5-6 celled, usually forming longitudinal septa in one or more cells at perpendicular to oblique angles to the cross septa; fusiform to elliptical in shape; the mature ascospore is usually larger at one end than the other because of by a smaller septal diameter at or near the median lengthoften giving the effect of a constricted spore; range in length is 25 to 40µ; the forward cell of the two celled immature ascospore formed by the initial transverse septum enlarges more than the lower cell; pigmentation begins to be visible at this stage, as well as a distinct echinulation formed on the outer wall surface; the two-celled ascospore measures 25μ in length and 8 across the widest cell; ascospore size may remain constant or increase up to 40μ in length and 12μ across the wider cell as the number of septa increase; additional cross septa form in each of the two cells; the ascospore may remain transversely septate, or characteristic longitudinal septa will develop in one or more of the ascospore cells. ASCUS eight-spored, with thickened wall at apex and lateral areas; apical chamber with distinct nasse apicale; in ascospore dispersal the inner wall layer extends well beyond outer wall layer in the bitunicate fashion; fasciculate, maturing sequentially, obtuse, ventricose; measuring 10-25μ at widest diameter, 65-100μ in length. HYMENIUM basal, asci serially maturing; aparaphysate. ASCOCARP WALL multilayered, comprised of textura angularis tissue, the cells larger and lighter pigmented in the wider median area; outer layer externally aparaphysate, with deep brown melanoid wall pigment; inner wall layers producing elongate periphysoids projecting into centrum cavity that seem to be the source of a hygroscopic gelatinous matrix filling the ascus chamber. ASCOCARP 100-150μ, ostiolate, becoming collabent at times, occurring singly or amassed in groups of up to 15; subtended by a sterile tissue stalk of almost imperceptible length to one cm in length.

ANAMORPH

Phaeoxyphiella fisheri Batista in Batista & Ciferri. Batista and Ciferri 1963b:148-149.
=*Phaeoxyphiella morototoni* Batista & Ciferri in Batista & Ciferri. Batista and Ciferri 1963b:149-150.
=*Phaeoxyphiella walteri* Batista, Nascimento & Ciferri in Batista and Ciferri. Batista and Ciferri 1963b:152-153.
[=*Hendersoniella* sp. described by Fisher 1933:187-188.]

CONIDIOSPORES formed in basal hymenial layer; linearly dispersed in dry catenate extrusion, with the acuminate straight to slightly curved and rounded pigmentless apex of one roughened conidium loosely adhering to the truncate base of

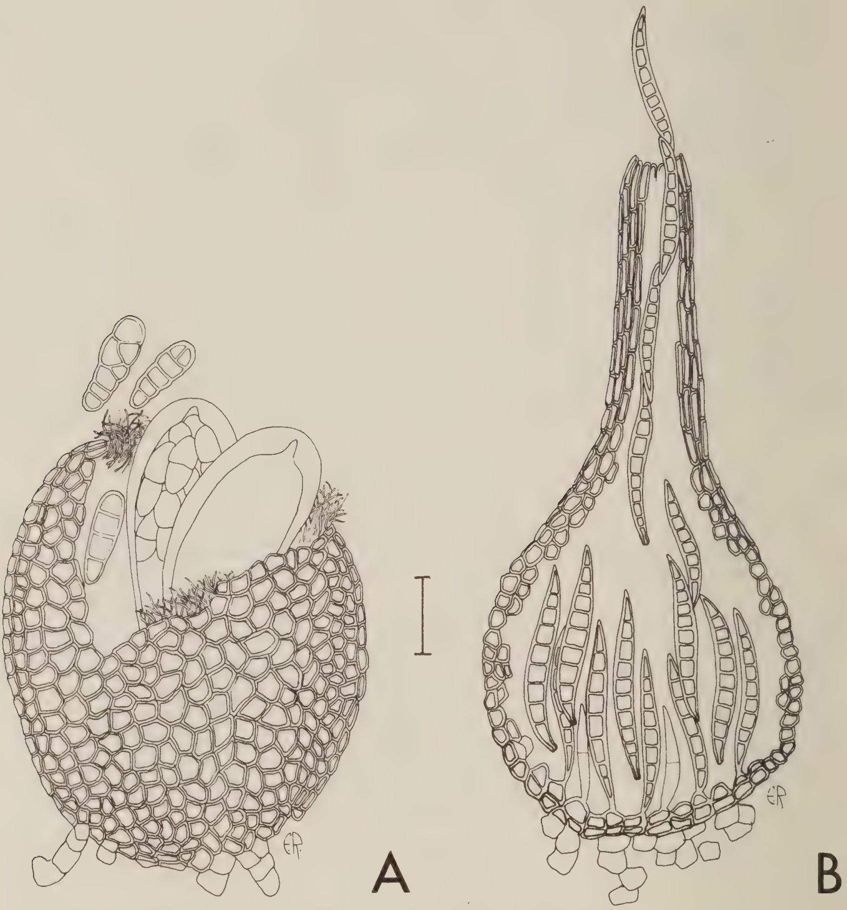

FIGURE 1. Diagramatic representations of the teleomorphic and anamorphic fruitbodies of Capnodium dematum (V. M. Miller & Bonar) Reynolds. A. Ascoma: Two asci extend among periphysoids from the apex of the broken ascocarp wall. Ascospores are shown as two-celled initials, and with transeptate to muriform septation. B. Conidioma: The pycnidium is shown as a longtudinal section. The basal conidiogenous cells produce conidia which become loosely attached, end on end, as they move through and beyond the pycnidial neck. Bar=20μ .

the darkly pigmented conidium in line above it; length 40-75μ; 4-8μ width at widest diameter; with 8 to 15 cross septa. CONIDIOGENOUS CELLS unicellular, hyaline, phialidic, solitary to multiconidiogenic, integrated into wall of conidiomata. PYCNIDIUM (conidium producing) with melanoid pigment in one or two outer layers of wall, comprised of textura globulosa tissue in the lower wall surrounding the conidiogenous centrum changing to textura prismatica tissue from the base of the neck onward to the ostiole; the innermost wall cells lining the conidiogenous centrum are hyaline; neck with central canal for spore dispersal 15-25μ in width, extending 45-80μ in length; lower area containing conidiogenous centrum 40-60μ in diameter and 65-85μ in height to base of neck.

Pure culture isolates were made from single and multiple conidia of P. fisheri, and ascospores of C. dematum on half-strength YMA agar (2g yeast, 5g malt extract, 2g glucose [or 4g sucrose], 15g agar, 1000ml distilled water) and Nitrogen Base Medium (10ml of a concentrate made from 5g KCl, 5g MgSO4.7H2O, 0.1g FeSo4.7H2O added to 1g K2HPO4, 3g NaNO3, 20g sucrose, 15g agar, 1000ml distilled water).

Germinating spores were observed in material collected from nature, as well as on the surface of the agar plates. On 2% plain agar, the hyphae from a germinating conidium were observed to grow downward through the agar with few hyphae developing near the agar surface.

The colonies on YMA agar grew to a diameter of one cm in 14 days. The three-dimensional mycelium remained tightly formed into a pulvinate mass, with no perceptible individual hyphae extending into the agar at any measurable distance. The mycelial mass was transferred to nitrogen base medium without agar and maintained on a shake table at approximately 850 revolutions/minute resulted in no discernable increase in mycelial mass nor change in colony morpholgy after two weeks.

Ascomata and conidiomata development was initiated through the cell division of a hyphal cell or from a cell of an ascospore or a conidium

The type specimen of Phaeosaccardinula dematia, H. E. Parks 2139, was also cited as the type of Naetrocymbe scoriadea Batista & Ciferri, and mentioned as an additional specimen of Leptocapnodium kramerii Batista & Ciferri by Batista and Ciferri (1963a) (with the collector misprinted as H. E. Parker).

Hughes (1976) predicted three Coelomycete taxa as the anamorphic component of Capnodium species, i.e. Fumagospora, Phaeoxyphiella and Scolecoxyphium. The proposed pleomorphy was based on concomitant occurrence in nature and the work of Fisher (1933, 1939) and Fraser (1934, 1935a, 1935b). Representatives of these asexual taxa occur in association with naturally occurring C. dematum. The conidial state later described as Phaeoxyphiella fisheri was suggested as the anamorph of C. dematum (Miller and Bonar, 1941), and has been culturally confirmed here. Fisher (1933), working with Australian species, failed to demonstrate pleomorphy between Phaeoxyphiella fisheri (as Hendersoniella sp.) and any ascosporic state; her spore-derived pure culture proof for the link between Capnodium salicinum Montagne and its anamorph in the same study is unquestionable.

The handwritten label on P. A. Saccardo specimen 2507, from Upper Yarra, Australia (LAM 202028), lists the names C. pelliculosum and C. ellisii Saccardo under C. walteri Saccardo. A coelomycete fitting the description of P. fisheri is present in the collection. I believe that the Saccardo species is based on heterogeneous material. The genus Capnodium is defined as having muriform ascospores (Reynolds, 1978). C. dematum produces ascospores with variable septation from transverse to muriform septation. Often the entire spore complement of an ascus will have only the transversely septate ascospores.

The other *Capnodium* species that has been suggested as having *Phaeoxyphiella fisheri* as its anamorph, *C. walteri* (Hughes, 1976), was described as having only transverse septate ascospores. Acceptance of this species into *Capnodium* as Hughes advocated (1976) raises a major question. A species with transverse to muriformseptate ascospores is acceptable into *Capnodium* as it now stands. To admit *C. walteri* as Fraser (1935b) described the species with only transversely septate ascospores requires an emendation of the genus. Or, the *Phaeoxyphiella* link must be accepted as a character uniting the variable spore septation pattern. Fraser (1935b) emended the Saccardo description of *C. walteri* without indicating that the type was reexamined; only material from the type locality was mentioned. None of the cited Fraser material that I examined had ascocarps of *Capnodium*; only *Phaeoxyphiella* fruitbodies were present. Obviously ascocarps were seen by her in some specimens that were the basis of the emendation. No designation was made in the list of examined specimens cited to indicate whether there was merely a presumption of pleomorphy and the presence of the supposed anamorphic state was taken as evidence of a *Capnodium* species.

The proof of pleomorphy accepted by Fraser (1935a, 1935b) was indirect, based on cultural characters of the hyphae, such as measurement of the diameter of the colonies. (In some cases only comparative hyphal morphology was used as pleomorphic proof rather than the unquestionable demonstration via production of reproductive structures from single spore isolates.) Fraser's approach to the demonstration of pleomorphy is also evident in her description (Fraser, 1935a) of a variety of *C. salicinum* based on supposed differences in pycnidial characters, including the septation of the conidium. Fisher (1933) had earlier culturally demonstrated a varability in the number of conidial septa in the anamorph of *Capnodium salicinum* from an "abnormal" single septum to conidia with "increased septation in a muriform conidium." Based on study of the California and Australian material of *C. dematum* I consider the pleomorphic link of *Capnodium* species with an anamorphic state other than *Phaeoxyphiella* to be tenuous until further data are available.

CALIFORNIA FUNGI MISDESCRIBED AS CAPNODIUM

1. *Capnodium spongiosum* Barr
   =*Capnophaeum spongiosum* (Barr) Batista &
    Ciferri. Batista and Ciferri 1963a:108
   =*Morfea alaskensis* (Saccardo & Scalia)
    Batista & Ciferri. Batista and Ciferri 1963a:142
   =*Limacinia alaskensis* Saccardo & Scalia
    Emended Barr. Barr 1955:501

The concept of *Capnodium* used by Barr (1955) was "species of sooty molds with muriform spores." The genus *Capnodium* sensu stricto of Hughes (1976) was characterized by sessile or shortly stalked ostiolate ascocarps without appendages; the ascospores were defined as transverseto muriform septate. Barr characterized the ascocarps of *C. spongiosum* as being appendaged and sessile, but occurring in or on a mycelial mat comprised of loosely tangled hyphae. Barr observed no longitudinal septa in the ascospores of the California material, although recent collections (LAM300844, LAM300845) demonstrate the variable septation of the ascospore in the California population of this species. The association of anamorphic states predicted for this species have yet to be validated (Barr, 1955; Hughes, 1974, 1976).

The *Morfea alaskensis* concept of Batista and Ciferri (1963a) was based on California material cited by Barr (1955) in her description of *Capnodium spongiosum*. The type material of *Limacinia alaskensis*, the supposed basionym of *M. alaskensis*, contains only immature ascocarps. Hughes (1974) provisionally included *M. alaskensis* as a synonym of *Euantennaria rhododendri* (Woronochin) Hughes.

Our collections of *Capnodium spongiosum* (LAM300846) are mixed with deuteromycete species in *Antennariella* and *Antennatula*. The logic of the Hughes's (1976) hyphal morphology system that redefines the capnodiaceous sooty molds would place Barr's California *C. spongiosum* in either one of two families. The pycnidium would indicate the ascomycete genus *Antennulariella* (allowing for muriform ascospores) of the Antennulariellaceae; the blastospore suggests the genus *Euantennaria* of the Euantennariaceae. Similar discrepancies can be noted (Hughes, 1968, 1972, 1976) for another California sooty mold, *Strigopodia batistae* Hughes, which has conidia attributed to it from his Euantennariaceae (*Antennatula*) and from his Metacapnodiaceae [=Capnodiaceae sensu Reynolds, 1985] (*Capnophialophora*) .

2. *Capnodium rhamni* Cooke & Harkness.

The original description of this species by Cook and Harkness (1884) makes this name an anamorphic one. The emended description by Batista and Ciferri (1963a) adds a teleomorph in such a way that the the holomorphn becomes a nomen confusum.

Cooke and Harkness (1884) described the conidia as uniseptate, darkly pigmented, 18-20 x 9 and associated with a sexual state. No asci were described in their material (Harkness #2482).

In Batista and Ciferri (1963a), the *C. rhamni* type was not declared as having been seen. Instead, California material (URM2380=IMUR5249 ex BPI) and another California collection (URM2807 =IMUR5669 ex UC) collected by H. E. Parks from Marin county were examined instead.

In their discussion of the URM2380 specimen under *Capnodium rhamni* Batista and Ciferri (1963a) mentioned that the material came to them from Herbarium BPI labeled as *Capnodium rhamni* on *Rhamnus californicus*; they found "only one species of *Phaeoxyphiella* and another one of *Asbolisia*." Batista and Ciferri's (1963b) description of *Phaeoxyphiella fisheri* Batista, Ciferri & Nascimento cites a Herbarium BPI collection with similar data as its type; no IMUR number was given. The specimen was collected "on leaves of *Rhamnus*, March 1931. Collected near Mirabel mine, Lake Co. Associated with *Asbolisia ampullula* Speg. In the same material we were not able to find *Capnodium rhamni* Cooke and Hark. as determined by H. E. and S. T. Parks. Miller and Bonar (1941) cite a specimen under their discussion of *C. rhamni* collected, "near Middletown, Lake Co., March, 1931, H. E. Parks 3581." Mirabell Mine is located four miles south of Middletown in Lake County, California (Yates and Hilpert, 1946).

Clearly, the material collected by H. E. Parks from Lake County was used for two species descriptions. The redescription of *Capnodium rhamni*, was based on a portion which was kept in Herbarium URM as IMUR 5249 (Batista and Ciferri, 1963a). The description of *Phaeoxyphiella fisheri* (Batista and Ciferri, 19963b) was based on the portion of the material returned to Herbarium BPI.

My examination of URM2380 (= IMUR 5249) revealed *P. fisheri*, *Asbolisia* sp., and sporulating *Hormonema ?prunorum* (Dennis & Buhagiar) Hermanides-Nijhof. Specimen URM2807 was cited by Batista and Ciferri (1963a) as a gift from Lee Bonar. The data given were "on *Rhamnus purshiana* D. C. , from Marin Co. California U.S.A., ex Herb. Univ. California, Leg. H. E. Parks, Febr. 19, 1931." The fungus present in the collection is *Vertixore atronitidum* V. M. Miller & Bonar.

Batista and Ciferri (1963a) redescribed *C. rhamni* "based on this very poor material." The apparent reference is to the two specimens cited as IMUR5249 and IMUR566N. The asci were said to be commonly "early evanescent", but were described anyway. I believe that the Batista and Ciferri redescription of *C. rhamni* is based on characters from unrelated species present in the collections they examined.

3. *Capnodium heteromeles* Cooke & Harkness.

This species is a nomen confusum. The description of the spores was tentative (Cooke and Harkness, 1884), made from "free sporidia and hence uncertain." The morphology of the spores was proposed as triseptate, muriform, darkly pigmented, 18 x 8 µ. The material in the type specimen, now located in Herbarium BPI rather than Herbarium CAS as stated in Miller and Bonar (1941), does not provide additional information about *C. heteromeles*. Batista and Ciferri (1963a) cited the binomial under "Excluded species of *Capnodium*" saying that "The spores are not surely recognizable."

Two concepts are outstanding for the California material. The W. C. Blasdale collections, LAM 200614, 200643, 200648, 202012 (= Ellis and Everhart, Fungi Columbiana 114 and North American Fungi 2918), made at the time that W. H. Harkness obtained his California material (LAM 200847), and a few years earlier than M. A. Howe collected material (LAM 200613) have the fruitbodies of the "*Capnodium citri*" pycnidium. *Chaetasbolisia californiana* Batista, Ciferri & Nascimento was described from Fungi Columbiana 114 (UC151179) (Batista and Ciferri, 1963b). The interpretation by V. M. Miller and L. Bonar, fifty years later, is supportive of the type description in septation, pigmentation and size of the supposed conidium, LAM 202010, 202068 (Ex California Fungi 603, H. E. Parks collection 3621) *Phaeochaetia arbutifoliae* Batista, Ciferri & Nascimento was described from California Fungi 603 (Ex UC756704) (Batista and Ciferri, 1962). Reynolds (1982) considered *P. arbutifoliae* and the California species, *Vertixore atronitidum* Miller & Bonar to be conspecific. The description of the latter species (Miller and Bonar, 1941) cited the H. E. Parks collection 3621 and *C. heteromeles* was mentioned as associated with it. Recent collections from the Berkeley area (LAM 300843, 300844, 300845) have conidiomata of these species.

Other taxa have been described from the type material of *C. heteromeles*. Cooke and Harkness (1884) described *Meliolopsis heteromeles* Cooke & Harkness and Batista and Ciferri (1963a) found *Naetrocymbe stevensonii* Batista & Ciferri on the Harkness collection of *Heteromeles* leaves. Reynolds (1971b) transferred both *M. heteromeles* and *N. stevensonii* to *Limacinula* as synonyms of *L. anomala* (Cooke & Harkness) Reynolds.

MISIDENTIFIED CALIFORNIA CAPNODIUM

1. Several collections labeled as *Capnodium salicinum* are mentioned in the literature. The California "*Capnodium*" ascospores in specimens associated with these reports that have been reexamined are too large for *C. salicinum* fide the Reynolds's (1978) restudy of the type. They are *Capnodium dematum*.

Batista and Ciferri (1963a) did not state that they examined the Montagne type of *C. salicinum* for their monograph of the Capnodiaceae; rather they cited a material from Contra Costa County collected in 1931 by Lee Bonar. This collection is one of *Capnodium dematum*, UC966391, that A. C. Batista (unpublished data from herbarium label) also listed as having *Capnodium salicinum*, *Phaeoxyphiella morototoni*, *Fumagospora gaultheriae* Batista & Vital, as well as *Morfea hendrickxii* (Hansford) Batista in the same collection. Collections from California were distributed as *Capnodium salicinum* Montagne in several exsiccati, including those of W. C. Blasdale in Ellis and Everhart's as Fungi Columbiani #112 and North America Fungi #2917, and that of H. E. Parks as California Fungi #257. Miller and Bonar (1941) cite a questioned *C. salicinum* determination on #112 as a specimen of *Phaeosaccardinula dematum*. Batista and Ciferri (1963a) cite the 2917 from P. A. Saccardo's herbarium as the type of *Capnodium baccharidis*.

Miller and Bonar (1941) refer a California collection to *Pleosphaeria salicina* (Mont.) Arnaud (Arnaud, 1911). They confusingly described a setose, globose fruitbody and a glabrous *Capnodium* -like fruitbody "as described by Arnaud" from collections found on the bark of *Baccharis pilularis* DC. subspecies *consanguinea* (DC.) Wolf from Marin and Santa Clara Counties.

Batista and Ciferri (1963b) cited a specimen of *Fumagospora gaultheriae* Batista, Vital & Ciferri associated with *Capnodium salicinum* from California on *Baccharis pilularis*, UC756704; this same collection (= LAM200744) serves as the type specimen of *Phaeochaetia arbutifoliae* Batista, Ciferri & Nascimento (Batista and Ciferri, 1962).

2. Several taxa have been described with darkly pigmented, muriform conidia. Most likely these fungi are related to the species cluster of *Fumagospora capnodioides* Arnaud, *F. cistophila* Batista & Ciferri and *F. gaultheriae* (Arnaud, 1911; Batista and Ciferri, 1963b).

a. *Capnodium elongatum* Berkeley & Desmazieres

A California specimen named *C. elongatum*, collection by Marshall A. Howe, 6 June (error for January, according to L. Bonar [unpublished data]) 1894, was cited under *Fumagospora gaultheriae* in Batista and Ciferri (1963b). Miller and Bonar (1941) mention a W. C. Blasdale specimen of *C. elongatum* from Berkeley.

b. *Capnodium caespitosum* Ellis & Everhart

This species was described from A. J. McClatchie collection 748, July 1894, Pasadena California. The pycnidia were described as subulate-cylindrical, collected into hemispherical clusters, subtended by sparse moniliform hyphae. The conidia were described as muriform, dark-brown, 12-20 x 7-10 μ. I have not seen the type specimen.

c. *Capnodium araucariae* Thümen

Thümen (1879) gave no description of the fruit-body and detailed the dark muriform spores without indicating their origin. Saccardo (1882) listed this species under "asci ignoti."

This species was reported from Berkeley by Miller and Bonar (1941) as ?*Polychaetella araucariae* (Thümen) Spegazzini. They note the paucity of details in accounts of the species and the absence of authentic determined material for use in the determination. The larger spores they utilized were "seen out of the perithecia;" smaller spores were observed in the ascocarps.

3. "*Capnodium citri* complex."

Several species in the sooty mold family Asbolisiaceae of Batista and Ciferri (1963b) have been referred to since the turn of the century in plant pathological literature as *Capnodium citri* (Farlow, 1876). This group of deuteromycetes, characterized by unicellular, hyaline conidia produced in pycnidia, are species in *Leptoxyphium*, *Podoxyphium*, and *Polychaeton* (unpublished data).

a. *Capnodium citri* Berkeley & Desmazières.

This name was used by Farlow (1876) for a California deuteromycete found on citrus and olive from San Diego and Santa Barbara. Batista and Ciferri (1963b) reinterpreted collections from Berkeley (W. C. Blasdale on citrus, March 1893) and Los Angeles (D. Coquillett on citrus, August 1889) as *Podoxyphium yuccae* Batista, Nascimento & Ciferri.

b. *Capnodium coffeae* Patouillard

Miller and Bonar (1941) uncertainly described under this name pycnidia under this name with hyaline conidia from Inverness Ridge in Marin County.

c. *Capnodium footii* Berkeley & Desmazières

Miller and Bonar (1941), citing a specimen (uncertain determination) from Berkeley, noted that they had only a pycnidiaceous sooty mold with hyaline, unicellular conidia. This is the same taxon that Batista and Ciferri cited from Moss (erroneously listed as Moon [L. Bonar, unpublished data]) Beach as *Scolecoxyphium* (*Microxyphium*) *americanum* Batista. I. Tavares (personal communication) noted a discrepancy between the conidial size reported for the species by Miller and Bonar (1941), 4-5 x 2-2.5μ, and Batista and Ciferri (1963a) for the generic description, 3-4.5 x 1-1.5μ.

d. Capnodium tuba Cooke & Harkness.

Cooke and Harkness (1884) did not see asci in their specimen #2395 from Palo Alto. The ascocarps were described as cylindrical and the questioned conidia were characterized as oval, nonseptate, and hyaline. Batista and Ciferri (1963a) transferred the Cooke and Harkness species to Morfea without seeing the type. They based the concept of their new combination on a another Herbarium BPI collection by J. P. Thom. According to them, "It is possible that this material, collected in the same state and on the same genus of the host plant, would be referable to Capnodium tuba, agreeing with the description of Cooke and Harkness of Capnodium tuba for perithecia , since the ascospores were not described."

Miller and Bonar (1941) cite specimens of C. tuba from Sausalito and Ross in Marin County, and from Wildcat Canyon in Contra Costa County consisting only of pycnidia.

SPECIMENS EXAMINED

The specimen data are listed, if known, in the following order: country; state and county, or comparable political division of a country; specific locality; collector and field number; date of collection; most original label determination (det.) and latest redetermination (redet.); associated plant; and curation history are given. The acronyms are those listed in the 1981, Edition 7, of the Index Herbariorum. All specimens examined in the course of this study are listed, whether referable to the species discussed or not.

Portions of a borrowed foliicolous fungal collection are many times retained by an investigator and added to an associated herbarium. This standard practice has, in my experience, resulted in multiple names for the same fungus, especially in the work of A. C. Batista and R. Ciferri. Knowing the collector of the specimen and the curation history as well are often a valuable aid in the interpretation of a species, especially where the material is scanty or no longer in good condition. Therefore, the herbaria where the specimen at hand has been curated as part of a larger portion are listed as part of the specimen data when these data are known.

AUSTRALIA. New South Wales: Ullaula, L. R. Fraser, April 1934, det. *Capnodium walteri*, on *Casuarina glauca*, LAM2009918 (Ex BPI, ex K), LAM200977 (Ex IMI26088). Victoria: Upper Yarra, Walter, det. *Capnodium walteri* and *Capnodium pelliculosum* and *Capnodium ellisii*, on *Bursaria spinosa* LAM200791 (Ex PAD2507, ex herbarium of P. A. Saccardo). Wyong, L. R. Fraser B101, 9 January 1935, det. *Capnodium walteri*, LAM200750 (Ex DAR12717=DAOM110692). National Park: L. R. Fraser A93, June 1933, det. *Capnodium walteri*, on *Dodonsea* sp., LAM200752 (Ex DAR14686). FRANCE. Eure-et-Loir. Dreux, Gallet and Feulleaubus 571, September 1883, det. *Capnodium footi* and *Fumago fagi*, LAM201523 (Ex ILL, ex C. Roumeguere Fungi Selecti Gallici Exsiccati 3096). ITALY. Palermo: V. Beltrami, October 1883, det. *Capnodium araucariae*, LAM200662 (Ex ILL, ex Rabenhorst Fungi Selecti Gallici 3051). Parma: G. Passerini, 1875, det. *Capnodium australe*, redet. *Fumagospora gaultheriae*, on *Alnus glutinosa*, LAM201241 (Ex URM4806=IMUR10905, ex P. A. Saccardo herbarium, ex Thümen Mycotheca Universalis 1350), LAM201242 (Ex URM4808 =IMUR10907, ex Thümen Herbarium Mycologicum Oeconomicum 433). Verona: 1876, det. *Fumagospora gaultheriae*, on *Alnus glutinosa*, LAM201232 (Ex URM4518=IMUR10616, ex P. A. Saccardo herbarium). PORTUGAL. Coimbra: A. F. Möller, August 1878, det. *Capnodium araucariae*, LAM201495 (Ex ILL, ex de Thümen, Mycotheca Universalis 1737). A. F. Möller, det.*Capnodium araucariae*, LAM201529 (Ex ILL, ex C. Roumeguere Fungi Selecti Gallici Exsiccati 5037). USA. California: Alameda County, Sunol, W. H. Harkness 2425, April 1881, det. *Meliopsis heteromeles* and *Capnodium heteromeles*, on *Heteromeles*, LAM200847 (Ex BPI, ex CAS1961). Alameda County, Berkeley, M. A. Howe, 15 June 1892, det. *Capnodium heteromeles*, on *Heteromeles arbutifolia*, LAM200613 (Ex

ILL6642, ex California Fungi). Alameda County, Berkeley, W. C. Blasdale, March 1893, det. *Capnodium heteromeles*, LAM200643 (Ex ILL, ex Ellis and Everhart, North American Fungi 2918) LAM200648 (Ex ILL, ex Ellis and Everhart Fungi Columbiani), LAM 202012 (Ex FLASf1870). Alameda County, Berkeley, University of California campus, Robert Ornduff, 5 February 1988, det. *Capnodium dematum*, on *Baccharus pilulans* LAM300844. Alameda County, Berkeley, University of California campus, Don R. Reynolds, November 1987, det. *Capnodium dematum*, on *Baccharus pilulans* LAM300843. Alameda County, Berkeley, University of California campus, Don R. Reynolds, 30 March 1988, det. *Capnodium dematum*, on *Baccharus pilulans* LAM300845. Contra Costa County, Mt. Diablo, W. H. Harkness 2482, May 1881?, det. *Capnodium rhamni*, LAM200874 (Ex URM2380=IMUR5249, ex BPI, ex CAS). Contra Costa County, north end of Wildcat Canyon, Lee Bonar, 21 April 1931, det. *Phaeosaccardinula dematia*, on *Baccharus pilulans*, LAM201029 (Ex UC966391, ex California Fungi 796), LAM205515 (Ex ILL,). Tilden Regional Park, Ron Rossa, 1969, det. *Phaeosaccardinula dematia*, on *Baccharus pilulans*, LAM205443 (Ex IMI142282). Del Norte County, South Fork of the Smith River, Rock Creek Lodge, W. B. Cooke and V. G. Cooke 25536, 16 August 1949, det. *Capnodium spongiosum*, on *Chamaecyparis lawsoniana*, UC915700 (Ex Mycobiota of North America 400). Del Norte County, Smith River Lodge, H. E. Parks 5174, September 1934, det. *Capnodium tuba* "conidial stage", on *Umbellaria californica*, LAM201226 (Ex URM2806=IMUR5668, ex UC, ex Fungi of California). Del Norte County, Smith River, H. E. Parks 5936, May 1937, det. *Arthroboytrum spongiosum*, redet. *Capnodium spongiosum*, redet. *Capnophaeum spongiosum*, on *Libocedrus decurrens*, LAM205509 (Ex UC692997), LAM205504 (Ex UC681382, ex California Fungi 418). Del Norte County, Smith River, Lee Bonar, 13 July 1933, det. *Arthrobotryum spongiosum*, redet. *Limacinia multiseptata*, on *Libocedrus decurrens*, LAM205507 (Ex UC960424). Marin County, H. E. Parks, 19 February 1931, det. *Capnodium rhamni*, LAM200875 (EX URM2807=IMUR5669, EX UC). Marin County, Inverness, H. E Parks, det. *Capnodium salicinum* plus *Chaetasbolisia*, redet.

Phaeosaccardinula dematia, on Baccharis pilularis, LAM201031 (Ex UC4394878, ex California Fungi 257). Marin County, Mt. Tamalpais, H. E. Parks 3065, det. Aithalomyces rhododendri, on Arctostaphlys sensitiva, LAM200583 (Ex ILL, ex UC21436). Marin County, Mt. Tamalpais, Fire Trail, H. E. Parks, 21 March 1926, det. Aithalomyces rhododendri, redet. Limacinia multiseptatum, redet. Ophiocapnocoma multiseptatum, on Manzanita, UC276037 (misprinted in Batista and Ciferri, 1963a as UC275037). Marin County. Marin County, Mt. Tamalpais, H. E. Parks 3406, April 1929, Aithaloderma rhododendri, on Arctostaphylos sensitiva, LAM200888 (EX UC371934). Marin County, Mt. Tamalpais, Vera Mentzer, March 1933, det. Aithalomyces rhododendri, redet. Limacinia multiseptata, on Arctostaphylos sensitiva, LAM205503 (Ex UC498813, ex California Fungi 301). Marin County, Mt. Tamalpais, Mill Valley, southside, Cascade Trail, W. B. Cooke 16789, 23 August 1942, det. Aithalomyces rhododendri, on Arctostaphylos sensitiva, LAM205508 (Ex UC681322). Marin County, east of Point Reyes lighthouse, Lee Bonar, 14 July 1939, det. Phaeosaccardinula dematia, on Baccharus pilulans, LAM201030 (Ex UC620826), LAM200620 (Ex ILL31390). San Mateo County, Moss Beach, H. E. Parks 2139, 17 April 1924, det. Phaeosaccardinula dematia, on Baccharis pilularis, LAM200885 (EX UC617322), LAM200622 (Ex ILL31509), LAM200504 (Ex URM9128 =IMUR13161, ex BPI). Sierra County, Sierra City, Don R. Reynolds, 9 April 1988, det. Capnodium spongiosum, on Libocedrus decurrens, LAM300846. Sonoma County, 2 miles east of Camp Meeker, M. A. Nobs and A. R. Kruckeberg, 28 September 1947, det. Arthrobotryum spongiosum, on Cupressus sargentii, LAM200483 (Ex UC960406). Sonoma County, between Knights and Alexander Valley, H. E. Parks 3622, 20 May 1931, det. Capnodium heteromeles , redet. Phaeosaccardinula anomala, on Photenia arbutifolia , LAM200550 (Ex URM12490=IMUR5276), LAM200615 (Ex ILL6644), LAM200744 (Ex UC75f6704, ex California fungi 603), LAM201512 (Ex FLASf41882). Washington: H. E. Bailey,, March 1935, Mt. Ranier National Park, Adelaide Lake, det. Phaeosaccardinula dematia, on Abies amabilis, LAM200481 (Ex UC620741).

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A NEW SPECIES OF GYMNOPILUS FROM NORTHERN CALIFORNIA

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This highly distinctive species of Gymnopilus, growing on fallen pine logs, was collected in Wunderlich Park in San Mateo County, California. The description which follows is taken from a thesis submitted to San Francisco State University in partial fulfillment of the Master of Arts degree in Biology (Seidl 1987).

The colors cited in the following description are from Kornerup and Wanscher (1978).

Gymnopilus thiersii Seidl, sp. nov. Fig. 1.

Pileus (1-2-)3-15 cm latus, primo convexus, deinde planus, postremo subdepressus, siccus, fibrillosus vel squamulosus discum versus, margine appendiculatus, initio omnino purpureo-brunneus, dein subflavidus et squamis subaurantio-brunneis vel rubello-brunneis tectus; vestigia veli partialis brunneolo-aurantia. Lamellae luteae vel subaurantio-brunneae, adnatae vel annexae, confertae. Stipes 3-10 cm longus x 0.7-3.2 cm crassus, aequalis vel attenuatus sursum, solidus, subfibrillosus, dilute aurantiacus, supra annulum vulgo purpureus; apex dense pruinosus, pruina e vinaceo albescens. Annulus apicalis, submembranaceus. Sporae 6-7.8 x 4.2-4.8(-5) um, ellipsoideae, asperae, in cumulo aurantiaco-brunneae. Cheilocystidia lecythiformia, hyalina.

Basidiocarpia solitaria vel gregaria, ad lignum arborum coniferarum. Holotypus: Wunderlich Park, San Mateo County, California, 13 March 1987, leg. M. T. Seidl 2291 (SFSU).

Pileus (1.2-)3-15 cm broad, convex expanding to plane or slightly depressed on disc, irregular in age, purple brown to reddish brown (8E7), margin inrolled, appendiculate with mandarin orange (6B8) to brownish orange (6C8) veil remnants, even, sometimes slightly hygrophanous,

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[1] Present address: University Herbarium, University of California, Berkeley, California 94720

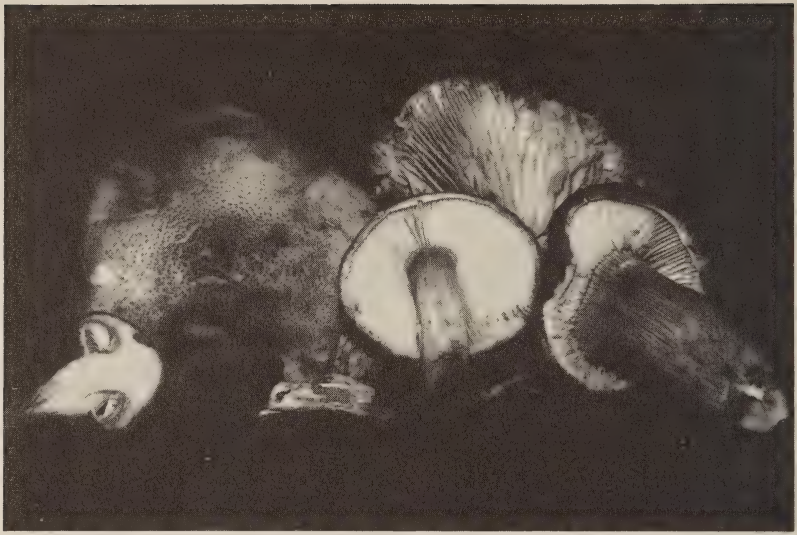

Fig. 1. Gymnopilus thiersii, holotype. Basidiomes ca. X .5.

always fibrillose; surface dry, fibrillose, becoming scaly towards the disc, scales becoming erect, rimose-areolate in mature specimens, light orange (5A4, 5A5) to reddish brown (8E7), background pale yellow (3A3) or pastel yellow (3A4), developing vinaceous tints or, rarely becoming watersoaked where injured; context up to 2 cm thick on disc, white to pallid becoming purplish red (14A8) to deep Magenta (14E8) above lamellae and yellowish above stipe. Taste slight to very acrid.

Lamellae adnate to adnexed, some with a decurrent tooth, crowded, edges becoming eroded in age, pale yellow (3A3), butter yellow (4A5), maize (4A6), sunflower (4A7), or deep yellow (4A8), becoming orange (6A8), dark orange or light brown (6D6) in age, bruising orange brown to brown where handled.

Stipe 3-10 cm long, apex 0.7-3.2 cm thick, equal or tapering upward, some flattened due to growth habit, attachment central to slightly eccentric, solid, surface streaked-fibrillose, pale orange (6A3) to greyish orange (6B3) background, purple (15C8) to dark purple (14F8) above annulus, sometimes with slight vinaceous tints below annulus, whitish tomentum at base, staining brownish orange (6C8) where handled, apex densely pruinose, pruina dark purple at first, becoming white when mature; annulus apical, submembranous, may appear densely fibrillose, usually persistent; context white becoming yellowish in center and vinaceous at margins.

Spores 6-7.8 x 4.2-4.8 um, ellipsoid, roughened, nondextrinoid, without germ pore, brown to rusty brown in Melzer's reagent; orange brown or reddish golden (6B8, 6C7, 6C8, 6D7) in mass. Basidia 27-40(-43.5) x 6-10 um, clavate, hyaline, guttulate, (two)four-sterigmate. Pleurocystidia lacking. Cheilocystidia lecythiform, hyaline, capitate or non-capitate, thin-walled, 34-38 x (3-4.5 at head) 8-13 um. Caulocystidia present. Lamellar trama of subparallel and slightly interwoven hyphae, rusty brown oleiferous hyphae apparent when mounted in 3% KOH. Hymenium orange brown, subhymenium light orange.

Cuticle of light brown, repent, cylindric to slightly inflated, thin-walled hyphae, 7.5-15 um in diam, with encrusting pigments and fascicles of hyphae; clavate encrusted pileocystidia present; pileus context of interwoven, cylindric to filamentous hyphae, slightly darker than cuticle with scattered orange brown oleiferous hyphae, 3-5.5 um in diam. Clamp connections present.

Habit, habitat and distribution. Solitary to gregarious. On fallen _Pinus radiata_ D. Don. (Monterey pine), erumpent between scales of outer bark. January to April. California.

Material examined. California: M. T. Seidl 2291 (HOLOTYPE: SFSU), M. T. Seidl 2305 (ISOTYPE: SFSU), Wunderlich Park, San Mateo County, California.

The burgundy, vinaceous or purplish tones present on the young unexpanded pileus and stipe make this species quite distinct. Singer (1986) refers to the following species with lilac or violet tones: _G. janthinosarx_ (Sing.)Sing., _G. calobasis_, _Pyrrhoglossum lilacipes_ Sing., and _P. lilacinum_ Horak. _Gymnopilus janthinosarx_ is from coniferous trees in Central Asia, has a lilac-violet context and a slightly viscid pileus (Singer 1949). _Gymnopilus calobasis_ is an unpublished species from Amazonia, and no data are available concerning its characteristics. The two species of _Pyrrhoglossum_ are characterized by an eccentric or lateral stipe, and are readily distinguished from _G. thiersii_. _Gymnopilus luteofolius_ (Pk.) Singer has a similarly colored pileus, but the contextual colors are different and the spores are dextrinoid (Hesler 1969). A related species, _G. viridans_ Murr., has nondextrinoid spores and lacks pleurocystidia, plus many other differences such as an umbonate pileus and in the colors of the basidiome. _Flammula purpurata_ Cke. et Mass. (now a _Gymnopilus_), described from Australia (Cleland 1976), appears to be the most closely related species, however, the basidiome is much smaller, may possess greenish tones on the pileus, lacks purple or vinaceous tones above the annulus, the spores are oblique and not ellipsoid, and cystidia are lacking.

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THE LICHENS OF SERPENTINE ROCKS AND SOILS IN CALIFORNIA

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SUMMARY

Seventy-six species of lichens in 33 genera were collected from serpentine rocks and soils at five locations in central California. This number was approximately double that of the genera and species reported for serpentine areas in Bosnia, Yugoslavia. None of the serpentine-endemic lichens reported for Bosnia were found in California; however, the prominent species on serpentine rocks were similar for both areas. Fourteen percent of the lichens found on California serpentine were cyanophilic, and 11 percent were endolithic; 12 percent of the lichens collected on the high-magnesium serpentine were identified by various authorities as calcareous species.

INTRODUCTION

The unusual floras of serpentine soils have been of interest to botanists around the world for hundreds of years. The paucity of species, dwarfism, xeromorphism, and endemism of these floras have been attributed to various chemical and physical factors (Brooks, 1987) including the following:

- low levels of plant nutrient in the soils;
- excesses of magnesium over calcium;
- high concentrations of phytotoxic chromium, nickel and cobalt; and
- the well-drained character of the shallow soils.

It has also been suggested that the growth of endemic plants on serpentine soils is related to the freedom from competition provided by the substrate rather than to specific nutritional requirements. The general consensus at present is that no single factor is responsible for the serpentine vegetation but that a combination of edaphic and biotic factors results in the unusual serpentine floras (Brooks, 1987).

The serpentine areas in the central coastal ranges of California have been studied by scientists of many disciplines (Whittaker, 1954, 1960; Barbour & Major, 1977; Kruckeberg, 1984a, 1984b, 1984c). Their reports contain examples of serpentine-endemic vascular plants, disjunct populations, and ecotypic variations; however, virtually no mention is made of the lichen or moss floras and their relationship to the serpentine substrate. The only field study to describe the lichen flora of serpentine substrates was performed by Ritter-Studnička and Klement (1968) in the Republic of Bosnia in Yugoslavia. The purpose of this study was to increase our knowledge of lichen floras on serpentine substrates by collecting, identifying, and comparing the lichens from five serpentine sites in California; in addition, comparisons were made between the lichen floras on serpentine substrates in Bosnia and in California.

METHODS

Five areas of serpentine substrate were located on the geological maps of California with the assistance of staff at the California Division of Mines and Geology (Fig. 1). The study sites chosen:

(1) include serpentine exposures distributed over the central portion of the state, (2) represent typical serpentine conditions, (3) have published analyses of the soil and rock substrates, and (4) have vascular plant species characteristic of and/or endemic to serpentine.

To ensure a complete sampling of the lichen flora, the author and a fellow botanist made at least two collection trips to each site (except for the Monkey Rock site which was visited only once by three botanists). The descriptive features of the study areas are given in Table 1; additional site information is found in Sigal (1975).

Lichens were identified using the most suitable keys and descriptions available for California's saxicolous lichen flora, which has been largely neglected except by Hasse (1913) and Herre (1910). In places where these sources were incomplete, it was necessary to use the more general works of Fink (1935), Howard (1950), Nearing (1947), and Duncan (1959). Saxicolous species were also studied by Wetmore (1968) and Brodo (1968). Although these latter manuscripts describe floras of eastern sections of the United States, they were helpful in some determinations.

Specimens in question were compared with known specimens in the herbaria at San Francisco State University and the University of California at Berkeley. Synonymy was a recurring problem, as were recent changes in nomenclature. The problem of comparing serpentine lichens in Bosnia with those in California was best expressed by Herre (1910): "Perhaps no more important work could be done than the careful overhauling of the synonymy of American lichens by someone who has access to the published exsiccata of Europe and America as well as the literature of the subject."

Collections that were particularly difficult to identify and that were not represented by specimens in the local herbaria were mailed to specialists for

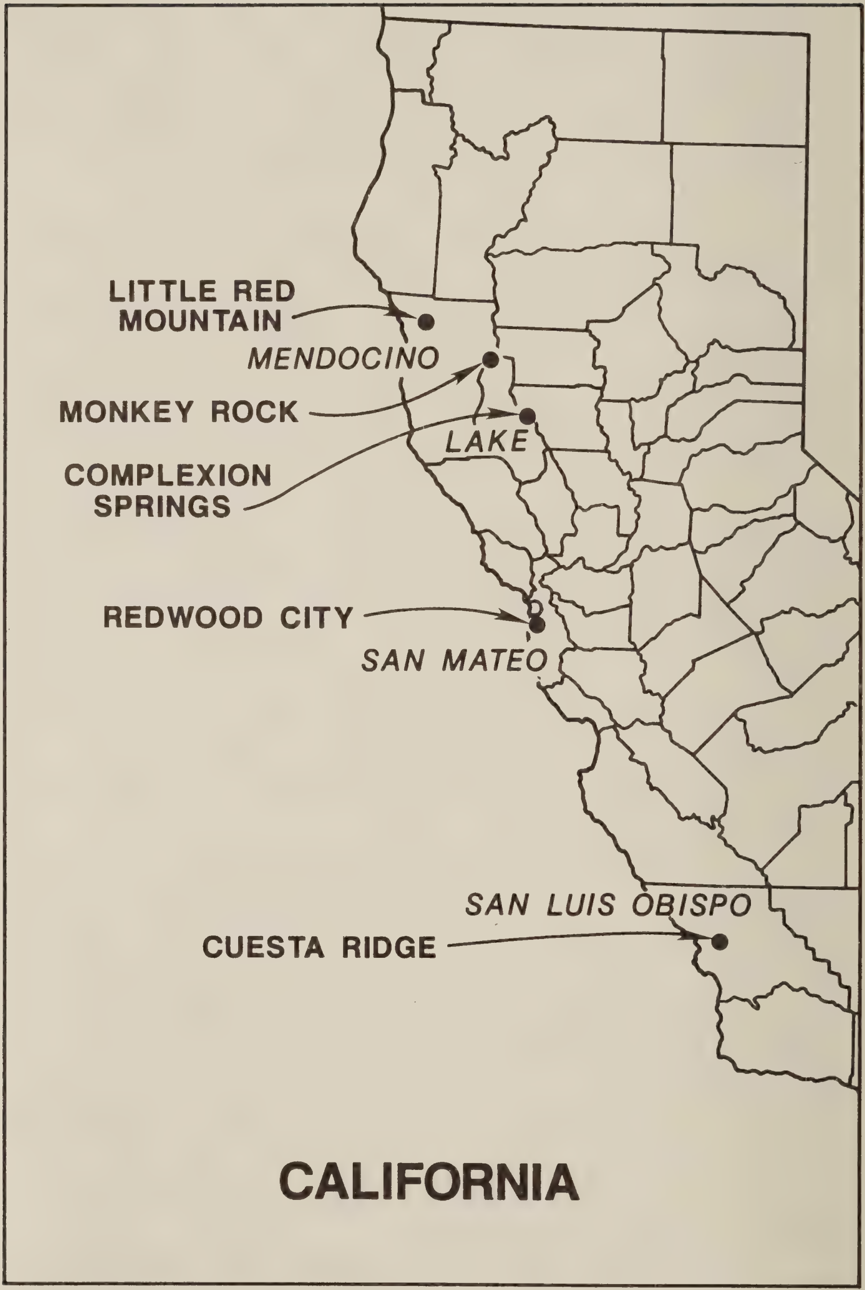
LITTLE RED MOUNTAIN
MENDOCINO
MONKEY ROCK
LAKE
COMPLEXION SPRINGS
REDWOOD CITY
SAN MATEO
SAN LUIS OBISPO
CUESTA RIDGE
CALIFORNIA

Fig. 1. Map of collection sites.

Table 1. Descriptive features of the study areas.

Site	Elevation	Temperature extremes (1963-1972)*	Annual precipitation (normal)*	Representative vascular plant species
Little Red Mountain, Mendocino County Legget Quadrangle R.5 E T.23 N	762 m	-7.8 to 37.7°C	180 cm	*Pinus attenuata* Lemmon *Cupressus sargentii* Jeps. *Onychium densum* Brack. *Libocedrus decurrens* Torr.
Complexion Springs, Lake County Clearlake Oaks Quadrangle R.6 W T.15 N	610 m	-6.6 to 40.6°C	58 cm	*Cupressus sargentii* *C. macnabiana* A. Murr. *Quercus durata* Jeps. *Garrya congdoni* Eastw. *Arctostaphylos viscida* Parry
Cuesta Ridge, San Luis Obispo County San Luis Obispo Quadrangle R.36 W T.29 S	610-762 m	-2.2 to 37.7°C	102 cm	*Cupressus sargentii* *Pinus coulteri* D. Don *Onychium densum* *Monardella palmeri* Gray *Chorizanthe breweri* Wats.
Redwood City, San Mateo County Woodside Quadrangle R.4 W T.11 S	183 m	-2.2 to 37.7°C	51 cm	*Quercus durata* *Lewisia redivia* Pursh *Mimulus douglasii* Gray *Fritillaria liliacea* Lindl. *Muilla maritima* Wats.
Monkey Rock, Hull Mountain, Mendocino County Hull Mountain Quadrangle R.10 W T.20 N	1,890 m	No information	140 cm	*Pinus jeffreyi* Grev. & Balf. *Libocedrus decurrens* *Quercus garryana* Dougl. var. *breweri* Jeps.

*U.S. Weather Bureau, 1963-1972.

confirmation or identification. Dr. John W. Thomson assisted with Verrucaria, Physcia, Dermatocarpon, and Aspicilia. A specimen and chromatogram of Xanthoparmelia cumberlandia (Gyeln.) Hale was sent to Dr. Mason E. Hale, Jr., for confirmation. A single collection of an unknown "Bacidia" from Complexion Springs was sent to Dr. Brian J. Coppins. He identified it as Ramonia gyalectiformis (Zahlbr.) Vězda and mailed the collection to Dr. Vězda for his comments. Dr. Coppins stated that as far as he knew, the species was known only from its type locality at Palm Springs (Hasse 1913).

Loans of material, particularly Lecidea, were made from Dr. Hannes Hertel, Dr. Chris Davidson, Dr. Howard Crum, Dr. John Thomas, and Dr. Isabelle Tavares. Species of the genus Aspicilia were a problem, and Dr. William Weber was consulted regarding this perplexing group. Collections were deposited at San Francisco State University. Nomenclature in this report follows that of Egan (1987).

RESULTS AND DISCUSSION

Seventy-six species of lichens in 33 genera were collected from the five serpentine sites (Table 2). Compared to the study by Ritter-Studnička and Klement (1968), which reported 39 species of lichens in 16 genera on serpentine in Bosnia, this study indicates the richness of the lichen flora of California serpentine.

For several reasons, the largest number of different lichens (42 species) was collected at Complexion Springs. This site had very large areas of weathered and unweathered serpentine as well as a constantly running stream that created yet another ecological niche. Although Little Red Mountain also had a constant water supply, fewer species (31) were collected at this site. The substrate was a fairly homogeneous dunite type of serpentine, and this characteristic probably explains the more limited number of species.

Both Redwood City and Cuesta Ridge lacked stream water, but the Redwood City site with 24 species consistently had more in common with Complexion Springs than with Cuesta Ridge (24 species). Species at Redwood City were similar to those at Complexion Springs, probably because the blue-green type of serpentine was common to both of these sites, whereas Cuesta Ridge consisted largely of outcroppings of a weathered, brownish peridotite type of serpentine.

Cuesta Ridge had 11 species that were found only at this southernmost site. Since neither climate nor substrate were substantial variables, one must consider other factors to explain the variation. Observers of the vascular plant flora indicate that the area of San Luis Obispo is unique for its number of endemic species. The flora of the Santa Lucia Mountains (Cuesta Ridge) contains many vascular plant species that have widely or markedly distinctive distributions due to isolation from connecting ranges. It appears that topography may influence also the lichen flora at Cuesta Ridge. Of the species found only at this site, *Thelidium* is considered a southern California lichen, and *Peltula omphaliza* is a distinctly southwestern species. *Lecanora argopholis* and three species of *Caloplaca* were unique to the southern collection site. In particular, *Caloplaca bolanderi*, with its outstanding iridescent red apothecia, was commonly present. The other species at Cuesta Ridge were also found at Complexion Springs and Little Red Mountain.

There were 15 species of lichens collected at Monkey Rock, eight of which were not found elsewhere. These eight were lichen species expected at higher altitudes.

Table 2. Lichen genera and species (according to Egan 1987).

	Taxon	Complexion Springs	Cuesta Ridge	Little Red Mountain	Redwood City	Monkey Rock
1.	Acarospora fuscata (Nyl.) Arnold	X	X	X		X
2.	Acarospora schleicheri (Ach.) Massal.	X				
3.	Aspicilia caesiocinerea (Nyl. ex Malbr.) Arnold*	X	X	X	X	X
4.	Aspicilia cinerea (L.) Körber	X				X
5.	Buellia badia (Fr.) Massal.	X				
6.	Buellia punctata (Hoffm.) Massal.				X	
7.	Buellia spuria (Schaerer) Anzi	X		X		
8.	Buellia stellulata (Taylor) Mudd					X
9.	Buellia vilis Th. Fr.	X		X		
10.	Caloplaca bolanderi (Tuck.) Magnusson		X	X		
11.	Caloplaca laeta Magnusson					X
12.	Caloplaca squamosa (B. de Lesd.) Zahlbr.	X	X	X	X	
13.	Caloplaca sp., Unknown #1		X			
14.	Caloplaca sp., Unknown #2	X				
15.	Candelaria concolor (Dickson) B. Stein		X			
16.	Candelariella vitellina (Hoffm.) Mull. Arg.	X	X	X	X	X
17.	Catapyrenium cinereum (Pers.) Körber*	X		X	X	
18.	Catapyrenium lachneum (Ach.) R. Sant*				X	
19.	Catillaria lenticularis (Ach.) Th. Fr.	X				
20.	Cladonia coniocraea auct. (fide Ahti)	X	X	X		
21.	Cladonia pyxidata (L.) Hoffm.	X		X	X	
22.	Dermatocarpon miniatum (L.) Mann var. complicatum (Light.) T. Fries*					X
23.	Dimelaena radiata (Tuck.) Hale & Culb.			X		

Table 2. Lichen genera and species - Cont.

	Taxon	Complexion Springs	Cuesta Ridge	Little Red Mountain	Redwood City	Monkey Rock
24.	Diploschistes scruposus (Schreber) Norman				X	
25.	Diplotomma alboatrum (Hoffm.) Flotow				X	
26.	Euopsis pulvinata (Schaerer) Nyl.*			X		
27.	Flavopunctelia flaventior (Stirton) Hale		X			
28.	Lecanora argopholis (Ach.) Ach.		X			
29.	Lecanora polytropa (Hoffm.) Rabenh.	X	X			
30.	Lecanora pulicaris (Pers.) Ach.	X				
31.	Lecanora rupicola (L.) Zahlbr.					X
32.	Lecanora scotopholis (Tuck.) Timdal	X				
33.	Lecanora sp.			X		
34.	Lecidea atrobrunnea (Ramond in Lam. & DC.) Schaerer	X				
35.	Lecidea fuscoatra (L.) Ach.			X		X
36.	Lecidea tessellata Flörke	X		X	X	
37.	Lecidea sp.	X		X		X
38.	Lecidella carpathica Körber	X	X	X	X	
39.	Lecidella stigmatea (Ach.) Hertel & Leuck.	X	X	X		
40.	Leptochidium albociliatum (Desmaz.) M. Choisy	X		X	X	
41.	Leptogium californicum Tuck.	X		X	X	
42.	Leptogium corniculatum (Hoffm.) Minks	X				
43.	Leptogium sp.			X		
44.	Pannaria leucophaea (Vahl) P. Jørg.			X		
45.	Parmeliella cyanolepra (Tuck.) Herre			X	X	
46.	Peltula bolanderi (Tuck.) Wetm.			X	X	

Table 2. Lichen genera and species - Cont.

	Taxon	Complexion Springs	Cuesta Ridge	Little Red Mountain	Redwood City	Monkey Rock
47.	*Peltula omphaliza* (Nyl. in Eckf.) Wetm.		X			
48.	*Physcia adscendens* (Fr.) H. Olivier		X			
49.	*Physcia stellaris* (L.) Nyl.					X
50.	*Physconia grisea* (Lam.) Poelt f. *isidiigera* (Zahlbr.) Thomson comb. nov.	X				
51.	*Physconia distorta* (With.) Laundon	X	X		X	
52.	*Placynthium nigrum* (Huds.) Gray*			X		
53.	*Psora globifera* (Ach.) Massal.*	X		X	X	
54.	*Psorula rufonigra* (Tuck.) G. Schneider			X		
55.	*Pyrenopsis phaeococca* Tuck.	X		X	X	
56.	*Ramonia gyalectiformis* (Zahlbr.) Vězda	X				
57.	*Rhizocarpon bolanderi* (Tuck.) Herre	X	X		X	
58.	*Rhizocarpon geographicum* (L.) DC.					X
59.	*Rhizocarpon grande* (Flörke ex Flotow) Arnold		X			
60.	*Rhizocarpon viridiatrum* (Wulfen) Körber	X				
61.	*Rhizoplaca chrysoleuca* (Sm.) Zopf.					X
62.	*Rhizoplaca melanophthalma* (DC. in Lam. & DC.) Ramond					X
63.	*Rinodina tephraspis* (Tuck.) Herre	X	X			
64.	*Tephromela atra* (Huds.) Hafellner				X	
65.	*Thelidium* sp.*		X			
66.	*Toninia aromatica* (Turner ex Sm.) Massal.	X		X		
67.	*Toninia squalida* (Schleicher ex Ach.) Massal.				X	

Table 2. Lichen genera and species - Cont.

Taxon	Complexion Springs	Cuesta Ridge	Little Red Mountain	Redwood City	Monkey Rock
68. Umbilicaria kraschenimnikovii (Savicz) Zahlbr.					X
69. Umbilicaria phaea Tuck.	X				X
70. Verrucaria aethiobola Wahlenb. in Ach.	X				
71. Verrucaria margacea (Walhenb. in Ach.) Wahlenb.	X				
72. Verrucaria muralis Ach.	X				
73. Verrucaria nigrescens Pers.*	X		X		
74. Verrucaria viridula (Schrader) Ach.	X		X		
75. Xanthoparmelia cumberlandia (Gyelnik) Hale	X	X			
76. Xanthoria sp.		X			

*Species considered to be calciphilous by various authors.

Of particular interest were the well-developed colonies of Rhizocarpon geographicum. Kruckeberg (1971) discusses R. geographicum in relation to serpentine: "Little is known yet about the edaphic preferences of bryophytes and lichens in the Pacific Northwest. One most striking case is the near absence on serpentine of the crustose lichen R. geographicum. It is plentiful on circumjacent nonserpentine rocks." In California I found R. geographicum on serpentine only at high-elevation sites.

There was another yellow Rhizocarpon on the serpentine at mid-elevation sites that at first was mistaken for a depauperate R. geographicum but was identified as R. viridiatrum on closer inspection. It was listed only for the Complexion Springs site, but I have also found thriving colonies at other serpentine sites, particularly the Elwell Ranch property at Cedar Mountain, Alameda County, California, and at Goodyear's Bar, Sierra County, California. Hasse (1913) cited a collection of R. viridiatrum on "trap" rock, and Herre (1910) noted a collection on sandstone, adding that R. viridiatrum was "a distinct species, very rare with us." It is possible that R. viridiatrum is a serpentine species since it is not commonly found elsewhere. Two collections were made of another lichen that, according to Herre (1910), is abundant on serpentine. Rinodina tephraspis was found at Complexion Springs and at Cuesta Ridge on the brownish, weathered peridotite.

When the identifications were completed, some general floristic patterns were detected. Whether these patterns are related to the chemical or physical factors of serpentine substrates has not been determined because the source of nutrients and elements and the effects of substrate on saxicolous lichen species are largely unknown. Nevertheless, 14 percent of the lichens found at the serpentine sites were cyanolichens compared to an estimated 8 percent of lichens worldwide (Hitch and Stewart, 1973). Galun et al. (1982) suggest that cyanophilous lichens adapt well to extreme physical conditions; they may also be tolerant of extreme chemical conditions. Endolithic lichens represent 11 percent of the species found on the various types of serpentine rock. Apothecia on the rock surfaces were the only clues to the presence of these lichens. At Monkey Rock, there were many well-developed apothecia of an unknown species of Lecidea on the slick, blue-green type of serpentine. Several species of Caloplaca were commonly endolithic, including: C. bolanderi, C. laeta, and C. "festiva" (identification uncertain). Lecanora polytropa was also present, recognizable by its light-brown, solitary apothecia scattered over the flat surfaces of the rocks as well as grouped in the crevices. There were several species of Verrucaria, their presence evident only by the partially innate perithecia, V. margacea and V. aethiobola in particular. Although these species were noted by Fink (1935) as having thalli that "sometimes disappear," the serpentine substrate appears to intensify the endolithic characteristic of the lichens for unknown reasons. A study by Wilson et al. (1981) on the weathering of serpentine by Lecanora atra suggested that lichens can sequester harmful ions in an amorphous silica gel that is formed from the oxalic acid secreted by the mycobiont and thus can tolerate high concentrations of phytotoxic elements. It is not known if the same strategy applies to endolithic lichen species on serpentine.

Twelve percent of the lichens collected on the high-magnesium serpentine were identified by various authorities as calcareous species. An outstanding example, the soil lichen Catapyrenium cinereum, was very abundant and obvious in the spring when mats of the squamulose thallus were still green and turgid from the rains. During the summer, the lichen was harder to find, because the thallus dried brown and blended with the soil. According to Dr. John W. Thomson, *C. cinereum* is distinctly a calciphilous lichen, yet, predictably, it is found on the soil in serpentine areas. Ritter-Studniĉka and Klement (1968) briefly mention "vague soil genera which also settle on chalk." They included in this group *Dermatocarpon miniatum*, *Candelariella vitellina*, *Physica caesia* (Hoffm.) Fürnr., and *Placodium saxicolum* (Poll.) Kbr. [syn: *Lecanora muralis* (Schreber) Rabenh.]. The species of *Dermatocarpon* and *Candelariella* listed above were found at the California study sites but not necessarily on soil. *Physcia caesia* was found on serpentine but not at the study sites; *L. muralis* was not found.

Hannes Hertel's monograph on *Lecidea* (1967), in which he describes calciphilous species in the Alps, mentions two species of *Lecidea* that were commonly found on the California serpentine: *Lecidea carpathica* (syn: Lecidella carpathica) and *Lecidea stigmatea* (syn: *Lecidella stigmatea*). *Lecidella carpathica* was also found in Bosnia, but *L. stigmatea* was not mentioned by Ritter-Studniĉka and Klement (1968).

When the lichens collected at each site were compared, a group of species was found occupying the serpentine rock at most of the sites. (These lichens presumably had similar gross ecological requirements.) They comprise the "lichen association" of the selected serpentine sites in California. Included in the group are *Aspicilia caesiocinerea*, *Lecidella carpathica*, *Rhizocarpon bolanderi*, *Caloplaca squamosa*, *Candelariella vitellina*, and *Acarospora fuscata*. Ritter-Studniĉka and Klement (1968) concluded that most of the lichens found on serpentine in Bosnia were members of the *Aspicilictum ochraceae*, a primary association. According to them, the lichens of this initial association occurred on slightly weathered serpentine along a watercourse, above the high-water mark. In abundantly settled lichen colonies on serpentine, they found that *Aspicilia caesiocinerea* and *Candelariella vitellina* were the most conspicuous species of the association. The same species were also among the dominant members of the lichen association on the California serpentine--an interesting parallel to report.

Ritter-Studnička and Klement consider the following four lichens to be found only on serpentine: *Rhizocarpon sphaericum* (Schaer.) Mig., *Aspicilia polychroma* (Anzi) Nyl. var. *ochraea* Anzi, *Aspicilia serpentinicola* (Suza) Ras., and *Aspicilia crusii* Klem. Specimens of *A. serpentinicola* were borrowed from Dr. Hannes Hertel in Munich because this species was not found on the sites studied in California. At the time of this study, the other two species of *Aspicilia* were considered European because they were not listed in Hale's checklist of North American lichens (1970); however, *A. polychroma* is listed in Egan's 1987 checklist. *Rhizocarpon spahaericum* (Schaer.) Mig. is synonymous with *R. effiguratum* (Anzi) Th. Fr., which is not considered to be serpentinicolous (W. Weber, personal communication). *R. sphaericum* has a bright yellow to whitish-yellow thallus and so differs markedly from the brown thallus of *R. bolanderi*, which is the *Rhizocarpon* found so commonly on the California serpentine. Because *R. sphaericum* has uniseptate spores and *R. viridiatrum* (also a yellow thallus) has multiseptate spores, these lichens are not likely to be confused. None of the European serpentine-endemic lichens were found at the study sites in California.

According to Ritter-Studnička and Klement (1968), the community changes as the serpentine weathers. They found that the *Aspicilictum ochraceae* association gave way to the more widely spread association of *Aspicilictum cinereae*, which is common throughout middle and southern Europe and generally occurs on silicate rocks. The *Aspicilictum cinereae* association differs from the *Aspicilictum ochraceae* in the absence of *Aspicilia polychroma* var. *ochracea* and *A*. *serpentinicola*. The "silica-genera" found on the serpentine in Bosnia, which were considered part of the *Aspicilictum cinereae* association, were remarkably similar to those found in California. The species common to both continents included *Lecidea carpatica* Körb. (syn: *Lecidella carpathica*), *Rhizocarpon geographicum*, *R*. *viridiatrum*, and *Aspicilia cinerea*. In Europe the association of *Aspicilictum cinereae* is succeeded by that of *Parmelietum molliusculae*. I found no evidence on the sites studied of such a foliose association becoming the climax vegetation. The most common foliose lichen found at the study areas was *Xanthoparmelia cumberlandia*, generally considered a pioneer species.

Discussion of the lichen flora of California serpentine is not complete until taxonomic uncertainties with the prominent *Aspicilia* cf. *caesiocinerea* Nyl. are described. The lichen is characterized by a variable rimose-areolate thallus with sunken apothecia and K-, C-, and I- thallus reactions; the exciple and hymenium of the apothecia have a wine-red I+ reaction. Multiple samples sent to two taxonomists were identified as *A*. *caesiocinerea* by one and *A*. cf. *calcarea* by the other. Comparison with the type specimen was not possible, but acceptance of the *A*. *caesiocinerea* determination further enhances the similarity between the lichen species found on serpentine in Bosnia and California.

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LEPIOTA SENSU LATO IN CALIFORNIA. III. SPECIES WITH A HYMENIFORM PILEIPELLIS.

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SUMMARY

Four species of *Lepiota*, each with a hymeniform pileipellis, are noted from California. Three are described and illustrated--*Lepiota cristata* (Bolt.: Fr.) Kummer, *L. neophana* Morgan, and *L. thiersii*. *Lepiota thiersii* has ovoid spores and agrees with the original diagnosis of *L. castaneidisca* Murrill. Because Murrill's species is actually a synonym of *L. cristata*, *L. thiersii* is described as new.

To my knowledge, the California mushroom flora has only four medium- to small-sized species of *Lepiota* S. F. Gray sensu lato that exhibit a hymeniform pileipellis. In addition to pileipellis anatomy and basidiome size, they share small spores (length = 8 µm or less) with walls inamyloid and weakly to not dextrinoid and an initially smooth, nonfibrillose pileipellis that in some species diffracts into more or less concentrically arranged scales. One species, *Lepiota luteophylla* Sundberg, was described previously (Sundberg 1971) and has since been reported from Michigan (Smith, Smith, and Weber 1979). The others are described below. With the exception of *Lepiota cristata* (Bolt.: Fr.) Kummer, these species are poorly known; one is described as new. All would be placed in section *Cristatae* Kühner following Singer (1975), but because of diversity in spore features, some workers (e.g., Bon 1981) align them in different sections.

In the descriptions below, colors in quotation marks are from Ridgway (1912). Herbarium abbreviations are according to Holmgren and Keuken (1974).

LEPIOTA CRISTATA (Bolt.: Fr.) Kummer. Der Führer in die Pilzkunde. p. 137. 1871. Figs. 1-2, 10-12.

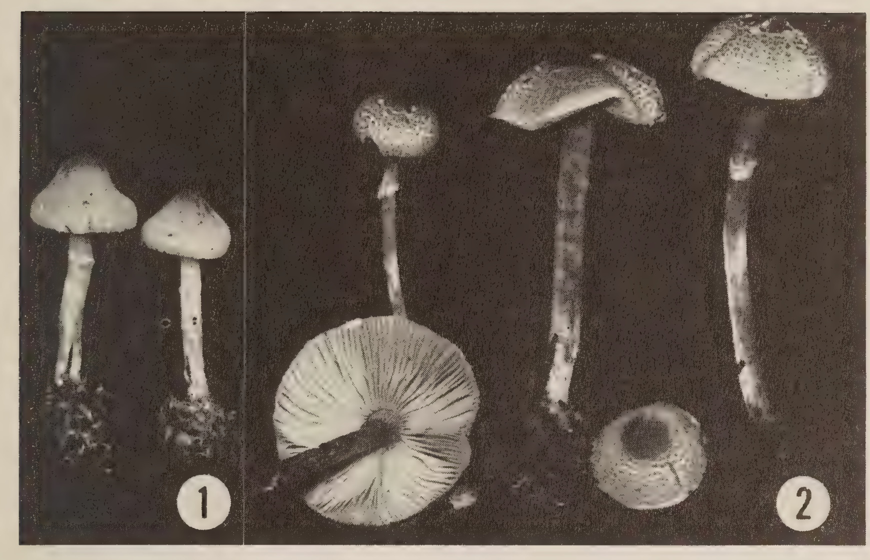
PILEUS 1-7 cm broad, almost conic at first, then convex to broadly convex, finally plano-convex in age; slightly to distinctly umbonate on expansion; margin at first incurved, appendiculate, and exceeding the lamellae, then decurved, plane to uplifted in age, entire, becoming rimose; surface dry; pileipellis continuous and glabrous at first, remaining so on the disc, becoming somewhat concentrically diffracted and appressed-scaly exposing the radially fibrillose flesh toward the margin, infrequently splitting radially, scales close to widely spaced, often evanescent near the margin; disc dark reddish brown ("carob brown", "chocolate", "chestnut", "bay", "walnut brown", or "burnt umber") to reddish brown ("cameo brown" to "warm sepia" to "verona brown"), sometimes as light as "russet" to pale "tawny" to "ochraceous-tawny", paler toward the margin, scales grading from concolorous near the disc to brownish pink ("fawn color" to "avellaneous") to "buff-pink" or sometimes "light vinaceous-cinnamon" to "light pinkish cinnamon" to "pinkish buff" toward the margin; exposed flesh white to "pale ochraceous-buff".

FLESH 1-3 mm thick at the disc, solid, fragile, white and unchanging. Taste farinaceous (disagreeable), rarely indistinct. Odor sweet and cinnamon-like to farinaceous, rarely mild.

LAMELLAE free, approximate; white, becoming "cartridge buff", "pale pinkish buff" to pale "warm buff"; close to subdistant; thin and fragile; somewhat ventricose; up to 4.5 mm broad; margins smooth, concolorous. Lamellulae in one to three tiers.

STIPE 3-12 cm long, 2-6 mm broad at the apex, equal to subbulbous; surface dry, almost glabrous at first, then innately fibrillose to appressed fibrillose, fibrils becoming loose in age; white to "pale pinkish buff" to "light pinkish cinnamon", often tinged "vinaceous" near the base, becoming "pale vinaceous" to "light russet vinaceous" to "snuff brown" to "sayal brown", at times almost gray when handled or in age, base clothed with white, rhizomorphic hairs; stuffed, becoming hollow; pith fibrils white, cortex white at first, toward the base becoming "vinaceous-fawn" to "vinaceous-brown".

ANNULUS occasionally persistent, submembranous, and



Figs. 1-2. *Lepiota cristata*. 1. Sundberg 474. X 1.
2. Sundberg XI-30-86-C-1. X 4/5.

flaring, more frequently collapsed against the stipe or remaining only as scattered patches of evanescent, tomentose to submembranous material, most often vanishing entirely; median to superior and white to "pale pinkish buff" when present.

SPORES pale "cream" in mass, 6.3-7.9 X 3-4.7 µm; bullet- or wedge-shaped and spurred opposite the hilar appendix, tapered toward the rounded apex, inequilateral, smooth, wall slightly thickened, apical pore absent, most uniguttulate, hyaline in KOH, inamyloid, not dextrinoid, pale to dark yellow in Melzer's reagent. BASIDIA 24-33 X 5-10 µm, clavate, 4-sterigmate, hyaline in KOH and Melzer's reagent. PLEUROCYSTIDIA lacking. CHEILOCYSTIDIA abundant, 22-45 X 10-14 µm; clavate to sphaeropedunculate, bases often long, narrow, and with flexous walls, smooth, hyaline in KOH and Melzer's reagent. LAMELLAR TRAMA parallel, hyaline in KOH and Melzer's reagent. PILEAL TRAMA interwoven, hyaline in KOH and Melzer's reagent. PILEIPELLIS a hymeniform layer of elongate-clavate to pyriform elements, surface covered with a thin amorphous layer; elements 34-74 X 9-16 µm, some rostrate or branched, dull rusty brown in mass and hyaline to pale brown when viewed singly in KOH and Melzer's reagent. Subcuticular layer interwoven, hyphae hyaline to rusty brown in KOH. CLAMP CONNECTIONS present.

HABIT AND HABITAT: Solitary to scattered in humus under conifers, hardwoods, and mixed woods. November to March.

COLLECTIONS EXAMINED: Alameda Co.: Thiers 7292 (SFSU). Butte Co.: Kowalski 960 (SFSU). Contra Costa Co.: Sundberg II-7-81-1 (SIU). Marin Co.: Sundberg 1732, 1777, 4068 (all SIU); Thiers 7326, 8517 (both SFSU). Mendocino Co.: Thiers 8187, 8500 (both SFSU). Monterey Co.: Thiers 11811 (SFSU). San Francisco Co.: Sundberg 1004; Thiers 8581 (both SFSU). San Mateo Co.: Sundberg 474, 1116 (both SFSU). Santa Barbara Co.: Sundberg I-7-83-5 (SIU). Santa Cruz Co.: Sundberg 1017 (SFSU). Solano Co.: Sundberg 1557 (SIU). Sonoma Co.: Sundberg XI-8-86-B-3 (SIU). Trinity Co.: Sundberg 1144 (SIU).

DISCUSSION: *Lepiota cristata* is widely distributed in California. It differs from other species in section *Cristatae* included here by formation of spurred spores--spores that are bullet- or wedge-shaped (more or less truncate) and spurred at the base opposite the hilar appendix. Because of this feature, some workers (e.g., Bon 1981) put *L. cristata* in section *Stenosporae* (Lange) Kuhner.

LEPIOTA THIERSII Sundberg, sp. nov. Figs. 3, 5-6.

Pileus 0.8-4 cm latus, convexus demum plano-convexus, siccus, glaber, ad marginum demum squamosus, cinnamomeo-brunneus, ad marginum pallide cinnamomeus vel subroso-bubalinus. Caro albus. Lamellae liberae, confertae, fere albus. Stipes 3-6 cm longus, 2.5-5 mm latus, glaber vel obscure fibrillosus, albus, basi cinnamonmeus vel pallide brunneus. Annulus evanescens. Sporae 4.7-6.3 X 3-3.9 µm, ovoideae vel breve ellipsoideae, non dextrinoideae vel amyloideae. Cheilocystidia nulla. Cuticula paliformis. Typus: United States, California, San Mateo County, San Francisco Water Department Property, February 10, 1970, Sundberg II-19-87-A-2 (Holotypus: SIU; Isotypus: SFSU).

PILEUS 0.8-4 cm broad, convex when young, then broadly convex, finally plane, often with a slight to broad, convex to flat umbo; margin incurved, appendiculate, and exceeding the lamellae at first, then decurved and entire, becoming plane, eroded to lacerate in age, appendiculate material thin, cottony to submembranous, fugacious; surface dry; pileipellis continuous and glabrous throughout at first, sometimes remaining so, usually becoming more or less concentrically diffracted and appressed-scaly exposing the radially fibrillose flesh toward the margin; scales elon-

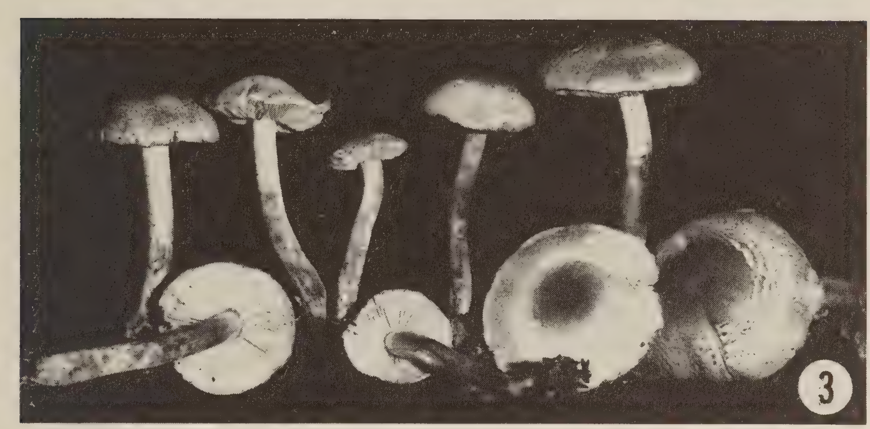


Fig. 3. *Lepiota thiersii*. Sundberg II-18-87-A-2. X 2/3.

gated along the pileus circumference near the disc, irregular in outline, smaller and more equal-sided toward the margin; flesh fibrillose and radially arranged between the scales; disc brown ("verona brown") to "cinnamon brown" to "clay color" to "cinnamon" to "pinkish cinnamon", rarely "warm buff" to "light buff", unbroken surface and scales grading from concolorous to "pale pinkish buff" near the margin, exposed flesh white to "pale pinkish buff".

FLESH 1-5 mm thick at the disc (at stipe edge), solid, white and unchanging. Taste disagreeable, farinaceous, rarely mild. Odor sweet-farinaceous to farinaceous, rarely indistinct.

LAMELLAE free, close to the stipe, infrequently forking and anastomosing near the stipe; white to off-white (pale "cream buff" to "pale pinkish buff"); close; thin and fragile; up to 5 mm broad, margin even, smooth, concolorous. Lamellulae in one to three tiers, free ends abruptly tapered but not truncate.

STIPE 3-6 cm long, 2.5-5 mm broad at the apex, equal; surface dry, innately fibrillose, white at first, becoming tinged "cinnamon-buff" to "cinnamon" to dark cinnamon-brown ("sayal brown" to "mikado brown") to pale brown toward the base in age or on handling, covered at the base by a white tomentum; stuffed, becoming hollow, pith fibrils white, cortex concolorous with the surface.

ANNULUS when present superior, submembranous, appressed to slightly flaring, very fragile, off-white, usually evanescent on most specimens, often leaving only a fibrillose zone or adhering to the pileus margin.

SPORES white (prints thin), 4.7-6.3 X 3.1-3.9 µm; ovoid to short ellipsoid, slightly inequilateral, smooth, apiculate, thin-walled, apical pore absent, uni- to biguttulate, hyaline in KOH, inamyloid, not dextrinoid, pale yellow in Melzer's reagent. BASIDIA 21-29 X 5-8 µm, clavate, 4-sterigmate, hyaline in KOH, hyaline to pale pinkish in Melzer's reagent. PLEUROCYSTIDIA lacking. LAMELLAR TRAMA subparallel to parallel, hyaline in KOH, hyaline to pale pinkish in Melzer's reagent; subhymenium cellular, concolorous. PILEAL TRAMA interwoven, hyaline in KOH, hyaline to pale pink (more reddish in mass) in Melzer's reagent. PILEIPELLIS an irregular and tightly arranged palisade of more or less clavate elements (often appearing somewhat cellular in thicker sections), surface covered with an amorphous material; elements 27-49(-90) X 9-20 µm, clavate, sometimes irregularly shaped, rarely branched, bases at times long and narrow, walls unevenly thickened, hyaline to pale yellowish brown in mass, and hyaline or with a yellowish brown content when viewed singly in KOH, more intense yellowish brown in Melzer's reagent; some subcuticular elements encrusted. CLAMP CONNECTIONS present at the base of the pileipellis elements and in the trama.

A pale yellow pigment, soluble in water but not alcohol, diffuses from the tissue during rehydration for sectioning.

HABIT AND HABITAT: Scattered to gregarious in humus under *Cupressus macrocarpa*. November through April.

COLLECTIONS EXAMINED: San Mateo Co.: Sundberg II-18-87-A-2 (Holotype, SIU; Isotype, SFSU); Sundberg 1125 (SFSU), 1842, 4153, 4192, II-20-87-6, II-20-87-8, II-20-87-9, II-20-87-11 (all SIU); Thiers 11934, 18832 23195, 24775, 24813, 33070 (all SFSU).

DISCUSSION: The specific epithet honors, with deepest gratitude, Dr. Harry D. Thiers who first collected the species and who introduced me to mycology.

This species agrees with the original description of *Lepiota castaneidisca* Murrill (1912). However, Murrill (1914) subsequently listed *L. castaneidisca* as synonomous with *L. cristata*. Type studies of *L. castaneidisca* by H. Smith (1966) and myself both confirm Murrill's conclusion. Therefore, this species is described here as new.

Lepiota thiersii is morphologically similiar to and usually exhibits the odor of *L. cristata*, but differs from it by usually lacking the reddish component in the pileus disc color and always having ovate rather than spurred spores. The formation of scales by the pileipellis on pileus expansion and a lighter colored stipe as well as the lack of both orange in the pileus color and grayish pileal trama

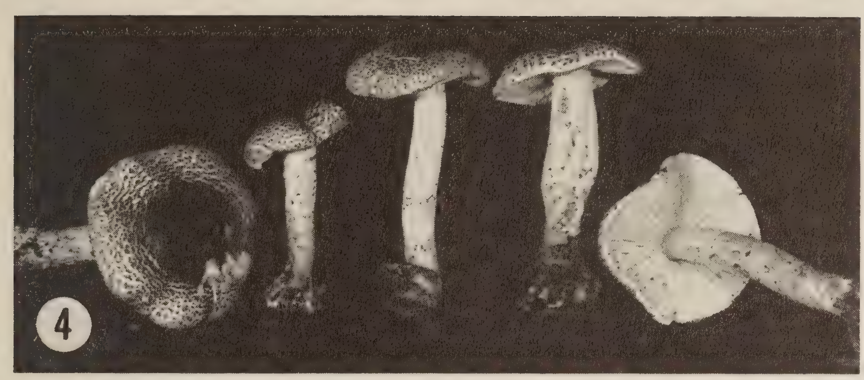


Fig. 4. *Lepiota neophana*. Sundberg II-20-87-A-1. X 1.

distinguish *L. thiersii* from *L. cristatoides* Einhellinger.

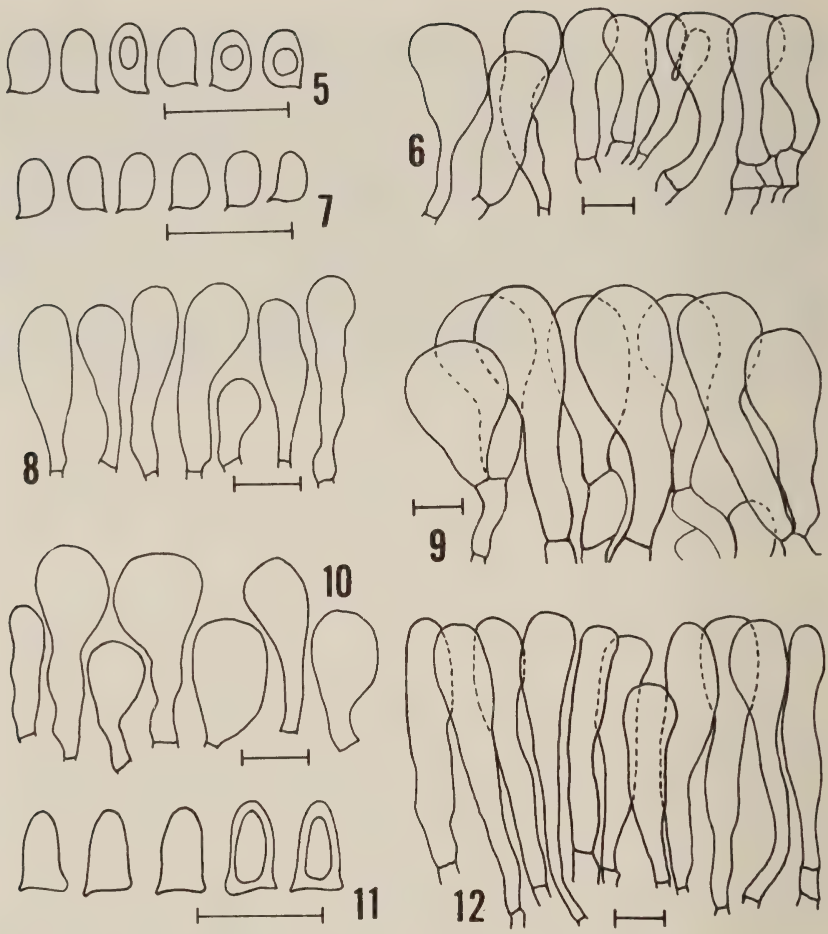
In Bon's (1981) system, *L. thiersii* would belong in section *Lilaceae* Bon.

LEPIOTA NEOPHANA Morgan. J. Mycol. 12: 248. 1906.
Figs. 4, 7-9.

PILEUS 1.8-3.7 cm broad, broadly convex to plane, often with a low broad umbo; margin appendiculate, exceeding the lamellae and incurved at first, becoming decurved to plane, entire to rimose, frequently undulating; surface moist to dry; pileipellis continuous, glabrous, and sometimes minutely rugulose on the disc, becoming more or less concentrically diffracted and appressed-scaly exposing the flesh toward the margin; scales irregular in outline, elongated along the pileus circumference near the disc and more uniformly equal-sided toward the margin; disc blackish brown to very dark brown ("fuscous" to "mummy brown" to "mars brown"), scales concolorous but most lacking black tinges to somewhat paler ("clove brown"), exposed flesh white at first, becoming very pale grayish olive ("olive-buff" to "pale olive-buff").

FLESH 1-3 mm thick at the disc (at stipe edge), solid, fragile, white, tinged "pale pinkish buff" under the disc, unchanging. Taste mild. Odor slightly pungent.

LAMELLAE free, approximate at first, but receding early, separated from the stipe by a collar-like band; white near the stipe, off-white ("cartridge buff") to "light buff" to "warm buff" elsewhere, unchanging; close to subdistant; thin and fragile; margins even, minutely fimbriate when



Figs. 5-12. Anatomical features of *Lepiota thiersii*, *L. neophana*, and *L. cristata*. 5-6. *L. thiersii*. 5. Basidiospores. 6. Elements of pileipellis. 7-9. *L. neophana*. 7. Basidiospores. 8. Cheilocystidia. 9. Elements of pileipellis. 10-12. *L. cristata*. 10. Cheilocystidia. 11. Basidiospore. 12. Elements of the pileipellis. Scale lines = 10 µm.

viewed with a hand lens, concolorous. Lamellulae in one to two tiers; free ends abruptly tapered but not truncate, sometimes anastomosing with longer lamellae.

STIPE 2.5-7.5 cm long, 2.5-6 mm broad at apex, equal; surface dry; glabrous to silky appressed fibrillose above, fibrillose to obscurely fibrillose scaly toward the base; white, becoming "pale pinkish buff" to "pale pinkish cinnamon", sometimes developing "cinnamon" to "orange-cinnamon" or brownish pink ("avellaneous", "vinaceous-fawn", or "fawn color") streaks and areas toward the base in age, "vinaceous" when bruised; clothed at the base with numerous, white to "pale cinnamon-pink to "light vinaceous-cinnamon" mycelial hairs that sheath it where buried in humus; stuffed becoming hollow, pith fibrils white, cortex white, "pale cinnamon-pink" to "light vinaceous-cinnamon" near the base.

ANNULUS lacking or if present forming only a fibrillose to appressed zone near the stipe apex, concolorous with the pileus surface.

SPORES "pale cream" in mass, 4.7-6.3 X 2.7-3.2 µm, ovoid to short ellipsoid, inequilateral, smooth, apiculate, thin-walled, apical pore lacking, most uniguttulate, hyaline in KOH, inamyloid, not dextrinoid, pale yellow in Melzer's reagent. BASIDIA 21-29(-34) X 5-7 µm, clavate, 4-sterigmate, hyaline in KOH and Melzer's reagent. CHEILOCYSTIDIA 19-48 X 6-11(-14) µm, abundant; clavate to elongate-clavate, some ventricose, infrequently rostrate, base narrow and elongate in most; walls thin, often flexuous; hyaline in KOH and Melzer's reagent. PLEUROCYSTIDIA absent. LAMELLAR TRAMA parallel to subparallel, hyaline in KOH, hyaline to pale pink in Melzer's reagent; subhymenium obscure, elements small, concolorous with trama. PILEAL TRAMA interwoven, hyaline in KOH, hyaline to pale pink in Melzer's reagent; oleiferous hyphae infrequently present. PILEIPELLIS a palisade of clavate to pyriform, rarely catenulate elements, surface covered with a hyaline amorphous material; elements 25-75(-87) X (11-)14-25 µm, rarely rostrate, some distorted and with flexuous walls, bases often narrow and elongate, walls thickened, pale yellow to pale yellowish brown in KOH and yellowish brown to dark reddish brown in Melzer's reagent, pigment in the walls. CLAMP CONNECTIONS present in the subcuticular layer, pileal trama, and lamellar trama.

HABIT AND HABITAT: Solitary to scattered in humus under *Cupressus macrocarpa*. December through April.

COLLECTIONS EXAMINED: Butte Co.: Kowalski 1281 (SFSU). San Mateo Co.: Sundberg 1093, 1126 (both SFSU), 1835, II-18-87-A1, II-20-87-1 (all SIU).

DISCUSSION: Known also from Ohio (Morgan 1906) and Michigan (Smith 1954), *L. neophana* is apparently widely distributed but is very infrequently reported. The dark color of the pileus readily distinguishes this species from others noted in this paper.

In Bon's (1981) treatment, *L. neophana* would belong in section *Lilaceae*.

ACKNOWLEDGMENTS

I wish to thank Dr. Harry D. Thiers of San Francisco State University for his friendship and guidance, for allowing use of specimens and photographs in his care, and for making my personal field observations possible through his collecting permit granted by the San Francisco Water Department. I also thank Dr. Barbara Thiers of the New York Botanical Garden for providing some needed literature and Dr. Mary Palm of the National Fungus Collections for her critical and valuable comments. The help of Dr. Charles Speck of Southern Illinois University in preparing the Latin diagnosis is appreciated. Funding provided for some of my field work by the American Philosophical Society Grant No. 1388--Johnson Fund is gratefully acknowledged.

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MYCOTAXON

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EXAMINATION OF STILBOTHAMNIUM TOGOENSE FOR ASPERGILLUS FLAVUS GROUP MYCOTOXINS.

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SUMMARY

Stilbothamnium togoense (=Aspergillus togoensis), a taxon considered by some to be related to the Aspergillus flavus group near A. tamarii, produced sclerotia when cultured on autoclaved oatmeal, but no A. flavus group mycotoxins (e.g. aflatoxins, sterigmatocystin, cyclopiazonic acid, kojic acid, dihydroxyaflavinine and aflatrem) were detected in extracts of the sclerotia or fermented meal. When cultured on autoclaved rice, S. togoense produced substantial quantities of sterigmatocystin which is believed to be an intermediate in the biosynthesis of aflatoxin. The data supports linking A. togoense to the A. flavus group because sterigmatocystin is not produced by species in the A. ochraceus group with which A. togoense also shares outstanding characteristics.

Stilbothamnium togoense Henn. [=Aspergillus togoensis (Henn.) Samson and Seifert] occurs in equatorial rainforests where it colonizes the seeds of fruit rotting on the forest floor. The fungus produces large synnemata (6-8 cm tall) with yellow to greenish or brownish, radiate conidial heads and is considered by Roquebert and Nicot (1985) to be related to the A. flavus group sensu Raper and Fennell (1965) near *Aspergillus tamarii* Kita. Roquebert and Nicot noted that the formation of a septum in the lower part of the phialide of *S. togoense* makes it different not only from *A. tamari* but from all other aspergilli as well. Samson and Seifert (1985) reduced *Stilbothamnium* to synonymy with *Aspergillus* retaining the species of *Stilbothamnium* in a separate subgenus. [i.e. *Aspergillus* subgenus *Stilbothamnium* (Henn.) Samson and Seifert]. They reasoned that there are numerous synnematous species in *Penicillium*, thus the production of such structures in connection with the *Aspergillus* anamorph should not serve to exclude those taxa from *Aspergillus*. The suggestion that *A. togoense* may be an ancestral form of the *A. flavus* group (Samson and Seifert, 1985) prompted us to investigate whether *S. togoense* produces any of the known mycotoxins (e.g. aflatoxin, aflatrem, dihydroxyaflavinine, kojic acid, cyclopiazonic acid, sterigmatocystin, and other aflatoxin-like metabolites) associated with different members of the *A. flavus* group [e.g. *A. flavus* var. *flavus* Link: Fr., *A. flavus* var. *parasiticus* (Speare) Kurtzman et al; *A. nomius* Kurtzman et al; and *A. tamarii*] (Dorner, 1983; Dorner et al., 1984; Kurtzman et al., 1987; Wicklow and Cole, 1982; Wicklow and Shotwell, 1983).

We examined two sclerotium producing strains of *S. togoense*: NRRL 13,551 (=LCP 67.3456; CBS 205.75) isolated by M.F. Roquebert from a seed of *Landolphia* sp. (Apocyanaceae) collected by R. Heim in 1967, near La Maboke, Central African Republic; and NRRL 13,550 (=LCP 64.1910) isolated by J. Nicot from undetermined seeds collected by R. Heim in 1964, near La Maboke, Central African Republic. Previous work has shown that substantial quantities of *A. flavus* group mycotoxins can be extracted from *A. flavus* sclerotia (Wicklow and Cole, 1982; Wicklow and Shotwell, 1983; Wicklow et al. 1988). Gram quantities of sclerotia were consistently produced by either strain when inoculated onto moistened, steam sterilized oatmeal or oat seed (D.T. Wicklow and C.E. McAlpin, unpublished). Samples of air-dried sclerotia (3 g) produced on oatmeal by both NRRL 13,550 and NRRL 13,551 were separately extracted and analyzed for *A. flavus* group mycotoxins (see above) according to the method described by Wicklow and Cole (1982). These mycotoxins were not detected in the sclerotia or in methanol extracts of the fermented oats.

Strain NRRL 13,550 was inoculated onto steam-sterilized rice (30% moisture content) and incubated at 25 C for 6 weeks. No sclerotia were produced by the fungus on rice. However, approximately 600 ug of sterigmatocystin was produced per gram of rice, determined by thin-layer chromatography as described by Vesonder and Horn (1985). Sterigmatocystin was isolated from the methanol extract of the rice and crystallized from ethyl acetate as pale yellow needles melting at 245 C. Conclusive identification was by comparisons of melting point, infrared (IR) and mass spectrum with that of a standard. No cyclopiazonic acid or aflatoxins were detected in methanol extracts of the fermented rice. Sterigmatocystins are produced by several species of *Aspergillus*, including some with the teleomorph state *Emericella*, the dematiaceous hyphomycete *Bipolaris* (=*Dreschlera*), and certain species of the ascomycete *Chaetomium* (Hamasaki and Hatsuda, 1977; Rabie et al., 1977; Udagawa et al. 1979). Sterigmatocystin has been proposed as an intermediate in aflatoxin biosynthesis and 14C-labeled sterigmatocystin is converted by *Aspergillus parasiticus* into aflatoxin B1 (Hsieh et al., 1973). At the same time, sterigmatocystin is not known to be produced by any species assigned to the *Aspergillus ochraceus* group (Cole and Cox, 1981) with which *S. togoense* also shares outstanding characteristics (Christensen, 1982). These analyses provide additional evidence linking *S. togoense* to the *A. flavus* group (Samson and Seifert, 1985).

ACKNOWLEDGEMENT

We take great pleasure in celebrating the pre-eminent mycological career of Professor Harry D. Thiers on his 70th birthday.

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THE OCCURRENCE OF VESICULAR-ARBUSCULAR MYCORRHIZAE IN BURNED AREAS OF THE SNAKE RIVER BIRDS OF PREY AREA, IDAHO.

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SUMMARY

Soils from 1981, 1983, and 1985 burn sites and an unburned site within the Snake River Birds of Prey Area were collected. All sites were vegetated primarily with _Artemisia tridentata_ Nutt. var. _wyomingensis_ (Beetle and Young) Walsh (big sage) which commonly forms vesicular-arbuscular mycorrhizae (VAM) for its healthy growth. These soils were investigated using pot culturing methods to determine if they contained active VAM fungal propagules. The results from pot cultures inoculated with the 1981 and 1983 soils showed that fungal propagules were present and actively infected 100% of the roots. With the 1985 burn soils, infection was much lower; only 50% of the roots from the pot cultures became infected.

Wildfires have beome an increasingly common occurrence within the Snake River Birds of Prey Area. Over the past ten years, 37% (90,000 acres) of the sagebrush-dominated rangeland has burned; and 80% (72,000 acres) of this burned in the past five years. _Artemisia tridentata_ Nutt. var. _wyomingensis_ (Beetle and Young) Walsh (big sage) is the dominant variety of sagebrush present. After a burn, the previously sagebrush-dominated area is revegetated by big sage and invading non-native grasses, particularly cheat grass (*Bromus tectorum* L.). After each fire more big sage is replaced by cheat grass, and eventually the area may be completely overrun by cheat grass. Cheat grass burns very quickly and therefore is hard to control. Repeated fires within these cheat grass-dominated regions result in a ripple effect. The fire burns the cheat grass and a zone of previously undisturbed big sage surrounding it. With each consecutive fire, these areas increase in size and more big sage is lost (Winward, 1985).

The big sage community supports high densities of black-tailed jack rabbits (*Lepus californicus* Gray). Jack rabbits are the main prey of golden eagles (*Aquila chrysaetos* L.), and research has shown a strong relationship between eagle productivity and jack rabbit abundance (U.S. Dep. Interior, 1979). The severe decline in jack rabbit numbers in recent years is thought to have been facilitated by the extensive loss of big sage habitat. There are concerns that the large loss of big sage may continue to maintain low jack rabbit numbers and resulting golden eagle numbers.

A positive solution to the problem is to revegetate these areas with the big sage soon after a burn, before the non-native grasses take a stronghold. The purpose of this study was to determine if VAM fungi, which are essential for the healthy growth of *A. tridentata* var. *wyomingensis* are present and remain active in soils after experiencing a recent burn.

MATERIALS AND METHODS

Soil samples, taken to depths of 15 cm, were collected from the rhizosphere of *Artemesia tridentata* var. *wyomingensis* at four different sites. The first collection site was from an unburned control area vegetated primarily with big sage. The remaining three sites were vegetated primarily with the big sage before experiencing a burn in 1981, 1983, or 1985. Three plots from each site were randomly selected.

Soil samples were used as inoculum for pot cultures the day after collection. For each plot, two pot cultures were inoculated, resulting in six pot cultures per site. An equal amount of inoculum soil was mixed with 500 g of sterilized, sandy garden soil. One control from each plot, in which the inoculum soil was sterilized as well, was prepared. All were then planted with surface sterilized seeds of sudan grass (*Sorghum vulgare* Pers var. *sudanese* Hitchc.). Pot cultures were watered, and received sixteen hours of light, daily.

The sudan grass was harvested three months after planting the seeds. Roots were removed with approximately 50 g of soil. This soil was washed from the roots using a strong stream of distilled water, and collected for wet sieving, following the sucrose centrifugation procedure in Daniels & Skipper, 1982.

Following the procedure of Phillips and Hayman (1970), sudan grass roots fixed in FAA were cleared and stained with trypan blue. The roots were then examined for mycorrhizal propagules.

RESULTS AND DISCUSSION

Table 1. shows the incidence of VAM infection within sudan grass roots. The results from pot cultures inoculated with the 1981 and 1983 soils show that fungal propagules were present and actively infected 100% of the roots. With the 1985 burn soils, infection was much lower. Only 50% of the sudan grass roots from the pot cultures became infected.

VAM spores were found within the filtrate of all soil samples, including controls, pointing toward possible contamination. However, only one of the twelve control soils had infected sudan grass roots (Table 1.), suggesting that sterilization of the soils inactivated, but did not disrupt or destroy spores. The VAM spore occurring most frequently in all soil filtrates was identified as the asexual chlamydospore of *Glomus microcarpus* Tul. & Tul. The spore is smooth, globose hyaline to light yellow, and approximately 50 um in diameter. It is attached singly to a hyphal extension. A large spore with a suspensor-like bulb attached to its base was found. This spore fit the description of the azygospores of the genus *Gigaspora* Gerdemann & Trappe.

Table 1.
VAM infection of sudan grass roots from pot cultures.

Soil Plots	Unburned	1981 Burn	1983 Burn	1985 Burn
1a	+	+	+	-
1b	*	*	+	-
2a	+	+	+	+
2b	*	+	+	+
3a	+	+	+	-
3b	+	+	*	-
Control 1	-	+	-	-
Control 2	-	-	-	-
Control 3	-	-	-	-

* = no plant

Also investigated was the incidence of VAM infection within recently burned A. tridentata var. wyomingensis roots from two of the 1985 sites. One site experienced fire of low intensity, while the other a fire of higher intensity. 67% of roots from the low intensity burn were infected, while only 18% of roots from the higher intensity burn were infected.

The preceding data suggest that VAM fungi are affected more adversely by a high intensity burn and that they recover from a burn within at most two years. However, after two years have passed, these areas are often highly invaded by cheat grass which does not normally form mycorrhizae. Therefore, areas experiencing a low intensity burn in which the mycorrhizae are not significantly reduced, should be revegetated that same year before cheat grass invasion. In high intensity burn areas in which mycorrhizae are significantly reduced, revegetation programs should begin one to two years after the fire, giving the mycorrhizal propagules time to increase in numbers. In this case, steps would have to be taken to eradicate the cheat grass before reseeding.

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MYCOTAXON

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COMPATIBILITY AND FRUITING STUDIES OF AN ALBINO FORM OF AURICULARIA CORNEA

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SUMMARY

Compatibility and fruiting studies were carried out with an *Auricularia* collection with white basidiocarps. Aside from the basidiocarp color, this collection was morphologically referable to *Auricularia cornea.* Mating studies determined this stock to be bifactorial and compatible with normally pigmented stocks of *A. cornea.* Fruiting studies demonstrated that the white basidiocarp characteristic is inherent rather than an environmentally induced feature. Interstock crosses between pigmented and white strains produced hybrid basidiocarps with normal pigmentation. Only pigmented basidiocarps were observed from intrastock crosses of compatible strains derived from hybrid basidiocarps. Based on mating and fruiting studies, it is concluded that the white basidiocarp collection is an albino form of *A. cornea.* Since only pigmented basidiocarps were observed in crosses between pigmented and white strains, a single gene, composed of a pair of dominant and recessive alleles, is thought to control pigmentation and albinism in basidiocarp color respectively. However, a Mendelian 3:1 ratio was not observed, and white basidiocarps were not recovered in self crosses of isolates derived from hybrid basidiocarps. The absence of white basidiocarps is thought to be due to the low number of compatible crosses utilized in this study.

INTRODUCTION

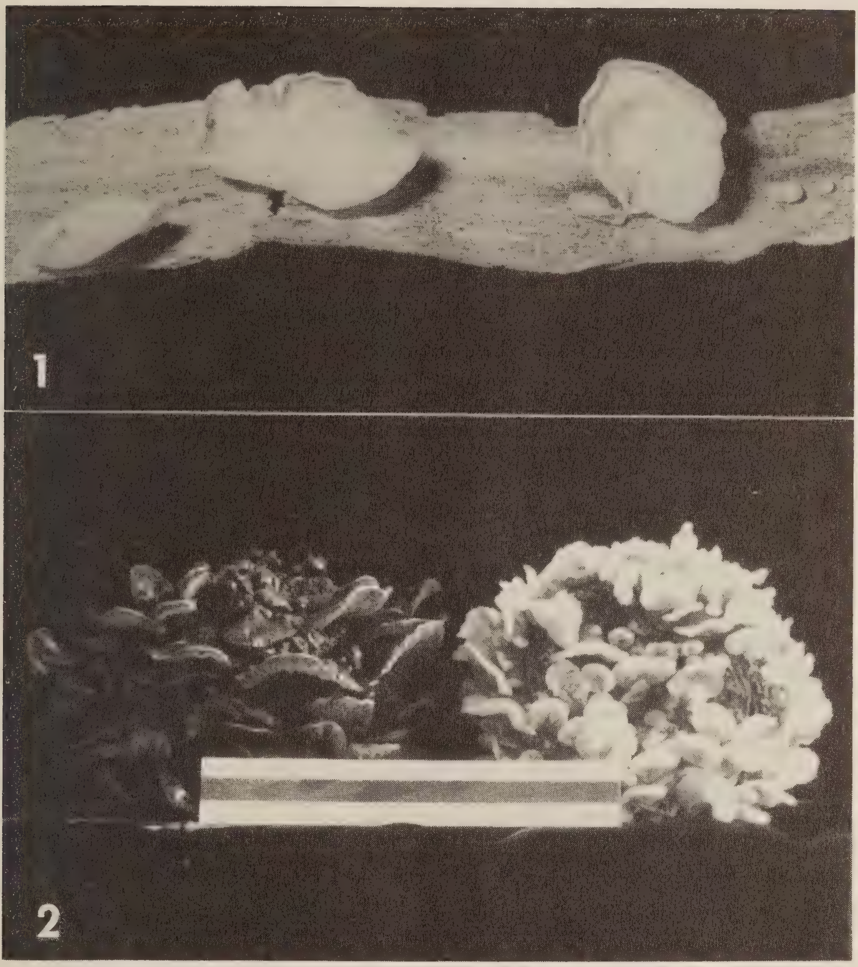
The first white species of *Auricularia* Bull.:Merat was described in 1872, as *A. albicans* Berk. (in Lloyd, 1925). There have since been two more white species of *Auricularia* described, *A. leucochroma* by

Kobayasi (1942), and *A. eburnea* by Li and Liu (1985). *Auricularia albicans* and *A. leucochroma* are presently recognized by Kobayasi (1981) as albino forms of *A. auricula-judae* (Bull.:Fr.) Schroet. and *A. polytricha* (Mont.) Sacc., respectively.

Incompatibility studies have only been carried out in four species of *Auricularia*: *A. auricula-judae*, *A. polytricha*, *A. delicata* (Fr.) P. Henn., and *A. fuscosuccinea* (Mont.) Farl. These studies have been reviewed by Wong and Wells (1987).

Other than in cultivation of *Auricularia polytricha*, there have been few fruiting studies carried out in this genus (Cheng and Tu, 1978; Quimio, 1982). Cheng and Tu (1979) described, macroscopically, basidiocarp development of *A. polytricha* grown in a sawdust and rice bran medium. Quimio (1982) studies the effects of aeration, light, and substrate supplementation on basidiocarp development. Hung (1983) described, macroscopically, basidiocarp development of *A. polytricha*, *A. fuscosuccinea*, and *A. mesenterica*. Mating and fruiting studies by Wong and Wells (1987) determined that the morphological differences between *A. cornea*, *A. polytricha*, and *A. tenuis sensu* Lowy (1951, 1952) and Kobayasi (1981), were environmentally induced, rather than inherent characteristics. Thus, the three species, in the sense of these authors are synonymous, and will, hereafter, be referred to as *A. cornea*, since it is the earliest species name validly published (Lowy, 1952).

A specimen of *Auricularia* (GJW 820) with white basidiocarps, morphologically referable to *A. cornea* [=*A. polytricha* f. *leucochroma* (Kobayasi) Kobayasi] (Fig.1), was collected in Hawaii, on the island of Oahu, along the Manoa Falls Trail. Based on the morphology, in cross section, *A. leucochroma* basidiocarps, Kobayasi (1981) reduced this species to a form of *A. cornea* under the name *A. polytricha* f. *leucochroma*. However, this has not been substantiated with genetic evidence. In order to determine if GJW 820 is referable to *A. cornea*, intrastock and interstock mating and fruiting studies were carried out. The criterion of compatibility between interstock crosses has been demonstrated as a useful tool in defining species in a number of studies (Boidin, 1986; Boidin and Lanquetin, 1984a,b; Capellano, 1985). However, partially sterile hybrids have been observed in interspecific crosses between *Typhula idahoensis* Rembsberg and *T. ishikariensis* Imai (Christen and Bruehl, 1979; Bruehl and Machtmes, 1980). Fruiting studies of this collection would also determine if the white basidiocarp condition is an inherent, or an environmentally induced condition. *Auricularia cornea* is defined here as having a medullated basidiocarp with abhymenial hairs approximately 200-600 ım in length. Lowy (1951, 1952) and Kobayasi (1981) also used the width and morphology of the medulla in defining species, but these characteristics have been demonstrated to vary according to environmental conditions and to intergrade in presently recognized species of *Auricularia* (Wong and Wells, 1987; Wong, unpubl.).



Figs. 1-2. *Auricularia* basidiocarps. 1. White basidiocarps of GJW 820. 1/2X. 2. Basidiocarps of GJW 820 (1 x 2) on right and basidiocarps of GJW 669 (9 x 11) on left. 1/3X.

MATERIALS AND METHODS

The method utilized for single spore isolation has previously been discussed (Wong and Wells, 1987). Mating strains derived from normally pigmented basidiocarps of *A. cornea*, GJW 802-18 ($A_{17}B_{11}$), GJW 802-16 (A_8B_{13}), GJW 669-9 (A_5B_3) and GJW 669-11 (A_6B_5), were isolated and identified by Wong and Wells (1987). Isolates were maintained on malt-yeast-soytone agar (MYP; Bandoni et al., 1975). Inocula and matings were made on 3% malt agar (MA; Wong and Wells, 1987). Crosses were

SEE ERRATA

made by cutting out 7 mm diameter plugs with a cork borer from the margins of inocula, and placing the inocula approximately 8 mm apart. After about 21-30 days, a small piece of agar was taken where the inocula have grown together, mounted in 3% KOH, and examined under phase optics.

The method used for fruiting has previously been described by Wong and Wells (1987). The substrate was made up of 6 parts sugar cane bagasse and 1 part Old Fashioned Quaker Oats. The sugar cane bagasse-rolled oats medium was thoroughly mixed with an equal volume of tap water, and excess water squeezed out, before placing the mixture in a 1000 ml beaker. The beaker was covered with a 23.5 cm^2 sheet of aluminum foil placed on top of a paper towel of equal area and held in place with a rubber band. The beaker was then autoclaved at 121°C for 90 min, followed by a 12 h cooling period. Following inoculation of the medium, the beaker was placed in the dark at 25°C until the mycelium had grown throughout the substrate. The substrate was then removed from the beaker and placed in a greenhouse with diffused lighting and an automatic misting system to keep the mycelium moist.

Specimens used in this study have been deposited at BISH, and representative mating strains from each stock have been stored at ATCC.

Hymenium colors, in brackets, of GJW 669, GJW 802 and basidiocarps formed from fruiting studies were cited from Ridgway (1912).

RESULTS

Intrastock crosses determined that GJW 820 was bifactorial. The results are summarized, and arranged according to their mating strains in Table I. The reactions are the same as those previously observed for *A. cornea* (Wong and Wells, 1987). Three types of reactions were observed in the contact zones where the monokaryons grew together:

A]B]: Clamp connections at most septa.
A]B=: False clamps at most septa.
A=B], or A=B=: Simple septa throughout.

Clamp connections were observed only in the contact zones. Nuclear migration apparently did not occur.

Compatible crosses of GJW 820 produced only white basidiocarps, while GJW 669 (9 x 11) and GJW 802 (16 x 18), under the same conditions, produced only pigmented basidiocarps (Fig. 2). Crosses between pigmented strains of *A. cornea* and GJW 820, GJW 820-1 x GJW 669-11 and GJW 820-1 x GJW 802-18, were compatible, and produced fertile, pigmented basidiocarps. Twelve single spore isolates were obtained from each hybrid basidiocarp, and crossed in all possible combinations in order to identify compatible crosses. Only pigmented basidiocarps were produced in the latter compatible crosses.

ERRATA

The guest co-editors of MYCOTAXON 34(1) wish to correct some editorial oversights. These oversights were the responsibility of the guest co-editors and **NOT** the fault of the respective authors.

*On p. 262, lines 30-32 should read:

A≠B≠: Clamp connections at most septa.
A≠B=: False clamps at most septa.
A=B≠, or A=B=: Simple septa throughout.

Table I

Pairing Reactions of GJW 820

	1	6	2	4	5	7	8	10	11	12	3	9
1	-	-	+	+	+	+	+	+	+	+	F	F
6		-	F	F	F	F	F	F	F	F	+	+
2			-	-	-	-	-	-	-	-	-	-
4				-	-	-	-	-	-	-	-	-
5					-	-	-	-	-	-	-	-
7						-	-	-	-	-	-	-
8							-	-	-	-	-	-
10								-	-	-	-	-
11									-	-	-	-
12										-	-	-
3											-	-
9												-

Symbols:

1. -: Contact zone with simple septa.
2. F: Contact zone with false clamps at most septa.
3. +: Contact zone with clamp connections at most septa.

Table II

Pairing reactions
of
GJW 820-1 X GJW 669-11

	1	7	3	8	12	4	9	10	2	5	6	11
1	-	-	-	-	-	+	+	+	F	F	F	F
7		-	-	-	-	*	*	+	F	F	F	F
3			-	-	-	+	+	+	F	F	F	F
8				-	-	F	F	F	*	+	+	+
12					-	F	F	F	+	+	+	+
4						-	-	-	-	-	-	-
9							-	-	-	-	-	-
10								-	-	-	-	-
2									-	-	-	-
5										-	-	-
6											-	-
11												-

Pairing reactions
of
GJW 820-1 X GJW 802-18

	1	2	4	5	9	10	11	7	3	8	12	6
1	-	-	-	-	-	-	-	-	F	F	F	+
2		-	-	-	-	-	-	-	F	F	F	+
4			-	-	-	-	-	-	F	F	F	+
5				-	-	-	-	-	F	F	F	+
9					-	-	-	-	F	F	F	+
10						-	-	-	F	F	F	+
11							-	-	F	F	F	+
7								-	+	+	+	F
3									-	-	-	-
8										-	-	-
12											-	-
6												-

* Denotes compatible crosses not producing basidiocarps.

Three compatible crosses did not produce basidiocarps in GJW 820-1 x GJW 669-11. The dikaryons of these crosses were slow growing and unable to infiltrate the bagasse-rolled oats substrate. The results of the interstock mating and fruiting studies are summarized in Table II.

The pigmented, field basidiocarps from Wong and Wells (1987) showed the most variability. GJW 669 was dark brown [Dark Livid Brown to Warm Blackish Brown], to brownish black [Dusky Brown to Blackish Brown (1)] when dry, and reddish brown [Mahogany Red to Chestnut] to brown [Auburn] when wet. GJW 802 was light brown [Cacao Brown to Walnut Brown] to brown [Hay's Brown to Seal Brown] when dry, and orange brown [Sayal Brown to Snuff Brown] to reddish brown [Vinaceous-Brown, or Sorghum Brown to Dark Vinaceous-Brown] when wet. Basidiocarps produced under greenhouse conditions were uniform with respect to color. The following crosses: GJW 669 (9 x 11), GJW 802 (16 x 18), GJW (820-1 x 669-11), GJW (820-1 x 802-18), GJW (820-1 x 669-11) self crosses, and GJW (820-1 x 802-18) self crosses, produced basidiocarps in the same color range. These basidiocarps were brown black [Dusky Brown to Blackish Brown (1)] to dark grayish black [Dusky Purplish Gray, or Dusky Neutral Gray] to black [Black] when dry, and dark reddish brown [Liver Brown, or Chocolate] to brown [Carob Brown, Burnt Umber, or Vandyke Brown] when wet.

DISCUSSION

The compatibility of interstock crosses between GJW 820 and pigmented stocks of *A. cornea* demonstrated that GJW 820 is referable to *A. cornea.* Hybrid basidiocarps, *i.e.*, basidiocarps derived from GJW 820-1 x GJW 669-11, produced morphologically normal basidiocarps with abundant basidiospores, and do not represent partially sterile hybrids as those observed in interspecific crosses between *Typhula idahoensis* and *T. ishikariensis* (Christen and Bruehl, 1979; Bruehl and Machtmes, 1980).

The characteristic of the white basidiocarp is inherent as demonstrated by intrastock crosses of GJW 820 (Fig. 2). Under the same environmental conditions, intrastock crosses of GJW 669 and GJW 802 produced only pigmented basidiocarps (Fig. 2). Thus, genetically, it has been verified that white basidiocarp variants that are morphologically referable to *A. cornea* are albino forms of this species as Kobayasi (1981) suggested.

Hybrid basidiocarps produced in this study were pigmented and uniform in color. This suggests that pigmentation is controlled by a single gene in which there is a dominant-recessive relationship in the pigmented and albino phenotypes. However, only pigmented basidiocarps were observed in compatible crosses in Table II, but because of the small number of compatible crosses fruited, a 3:1 Mendelian ratio of pigmented to albino basidiocarps should not be expected.

The occurrence of the *A. cornea* albino form in Hawaii is rare. In the five years that I have collected in Hawaii, GJW 820 has been the only albino collection of *A. cornea* observed. The albino form also appears to be rare elsewhere, since Lowy (1951, 1952) did not record the occurrence of albinism in his treatment of *Auricularia.* Kobayasi (1981) recorded albino forms of *A. cornea*, as well as several other *Auricularia* species, but did not comment on the frequency of their occurrence in nature.

The verification of GJW 820, as an albino form of *A. cornea* places another synonym under this species name. However, this has been done in concept only. Because a type probably does not exist for *A. cornea*, a neotype must be designated before *A. cornea*, *A. polytricha*, *A. tenuis*, and the albino form for this species can be reduced to synonymy.

ACKNOWLEDGEMENTS

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MYCOTAXON

Vol. XXXIV, No. 1, pp. 269-276 January 20, 1989

TYPE SPECIMENS OF AGARICS, BOLETES AND GASTEROMYCETES IN THE SAN FRANCISCO STATE UNIVERSITY HERBARIUM (SFSU)

BARBARA M. THIERS and ROY E. HALLING

Cryptogamic Herbarium
New York Botanical Garden
Bronx, NY 10458-5126

Agaricus amicosus Kerrigan, Mycotaxon **(this issue)** 1989. COLORADO. Grand Co.: Robber's Roost, 21 Aug 1983, *Kerrigan 1258.*

A. arorae Kerrigan, Mycotaxon 22: 427. 1985. CALIFORNIA. Santa Cruz Co., in live oak duff; Cap. Ext. Cemetery, 25 Nov 1981, *Kerrigan 1199.*

A. cuniculicola Kerrigan, Mycotaxon **(this issue)** 1989. COLORADO. Grand Co.: Willow Creek Pass summit, 22 Aug 1983, *Kerrigan 1271.*

A. fuscovelatus Kerrigan, Mycotaxon 22: 424. 1985. CALIFORNIA. San Francisco Co.: San Francisco, under *Cupressus macrocarpus*, SW corner of Sunset Ave. & Lawton St., 8 Nov 1977, *Kerrigan 791.*

A. perobscurus Kerrigan, Mycotaxon 22: 432. 1985. CALIFORNIA. San Francisco Co.: San Francisco, Cliff House, gregarious in soil under cypress, 24 Apr 1967, *Thiers 19004* (leg. W. Sundberg).

A. rubronanus Kerrigan, Mycotaxon 22: 426. 1985. CALIFORNIA. San Mateo Co: Colma, in cypress duff outside Ann. Cemetery, 7 Dec 1981, *Kerrigan 1204.*

A. sequoiae Kerrigan, Mycotaxon 22: 420. 1985. CALIFORNIA. Mendocino Co.: Mendocino Woodlands Camp, near Mendocino, 20 Nov 1977, *Kerrigan 824.*

A. summensis Kerrigan, Mycotaxon 22: 431. 1985. CALIFORNIA. Santa Cruz Co.: M. E. Loghry Forest CRSP, solitary at edge of dirt road, 6 Mar 1977, *Kerrigan 661.*

A. smithii Kerrigan, Mycotaxon 22: 428. 1985. CALIFORNIA. Humboldt Co.: Patrick's Pt. State Park, scattered in humus in mixed woods, 12 Nov 1967, *Thiers 21494*

A. vinaceovirens Kerrigan, Mycotaxon 22: 422. 1985. CALIFORNIA. San Mateo Co.: Colma, in a 10' ring in bare lawn under cypress and *Acacia*, 7 Oct 1977, *Kerrigan 730.*

Amanita breckonii Thiers & Ammirati, Mycotaxon 15: 156. 1982. CALIFORNIA. San Francisco Co.: San Francisco State University, scattered under *Pinus radiatus*, 12 Sep 1968, *Breckon 658.*

A. constricta Thiers & Ammirati, Mycotaxon 15: 163. 1982. CALIFORNIA. San Mateo Co.: San Francisco Watershed, scattered to solitary under madrone and oaks, 22 Jan 1965, *Breckon 302.*

A. magniverrucata Thiers & Ammirati, Mycotaxon 15: 161. 1982. CALIFORNIA. San Mateo Co.: San Francisco Watershed, 13 Mar 1970, *Keller 801.*

A. pachycolea Stuntz *in* Thiers & Ammirati, Mycotaxon 15: 158. 1982. CALIFORNIA. Mendocino Co.: Jackson State Forest near Mendocino, 14 Nov 1967, *Thiers 21502.*

Arcangeliella desjardinii Thiers, Sydowia 37: 300. 1984 (1985). CALIFORNIA. Mendocino Co.: Jackson State Forest near Mendocino, gregarious along road cut, under Douglas fir, 22 Nov 1981, *Thiers 44020.*

A. parva Thiers, Sydowia 37: 301. 1984 (1985). CALIFORNIA. Sierra Co.: approx. 6 mi N of Sattley on Hwy. 89, buried completely in soil under pines and firs, 14 Jun 1983, *Thiers 45906.*

A. saylorii Thiers, Sydowia 37: 302. 1984 (1985). CALIFORNIA. Eldorado Co.: Silver Fork Rd., off Hwy 50 at China Flat, hypogeous under *Abies*, 8 Jul 1983, *Saylor 1571.*

A. variegata Thiers, Beih. Sydowia 8: 383. 1979. CALIFORNIA. Mendocino Co.: Hwy 20 between Ft. Bragg and Willits, gregarious in humus in mixed woods, 1 Dec 1967, *Thiers 21738*

Armillaria olida Thiers & Sundberg, Madroño 23: 451. 1976. CALIFORNIA. Eldorado Co.: Crystal Basin Recreation Area, Hwy. 50, 6 May 1972, *Thiers 28816.*

Boletus abieticola Thiers, Calif. Mushrooms: A field guide to the boletes, 39. 1975. CALIFORNIA. Siskiyou Co.: Mt. Shasta, Wagon Camp, in soil under duff under *Abies concolor*, 5700 ft, 8 Aug 1967, *W. B. Cooke 38653.*

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A FESTSCHRIFT IN HONOR OF HARRY D. THIERS

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MYCOTAXON

Vol. XXXIV, No. 2, pp. 277-281 January-March 1989

THE ANAMORPHS OF DIATRYPELLA PROMINENS AND EUTYPELLA SABALINA

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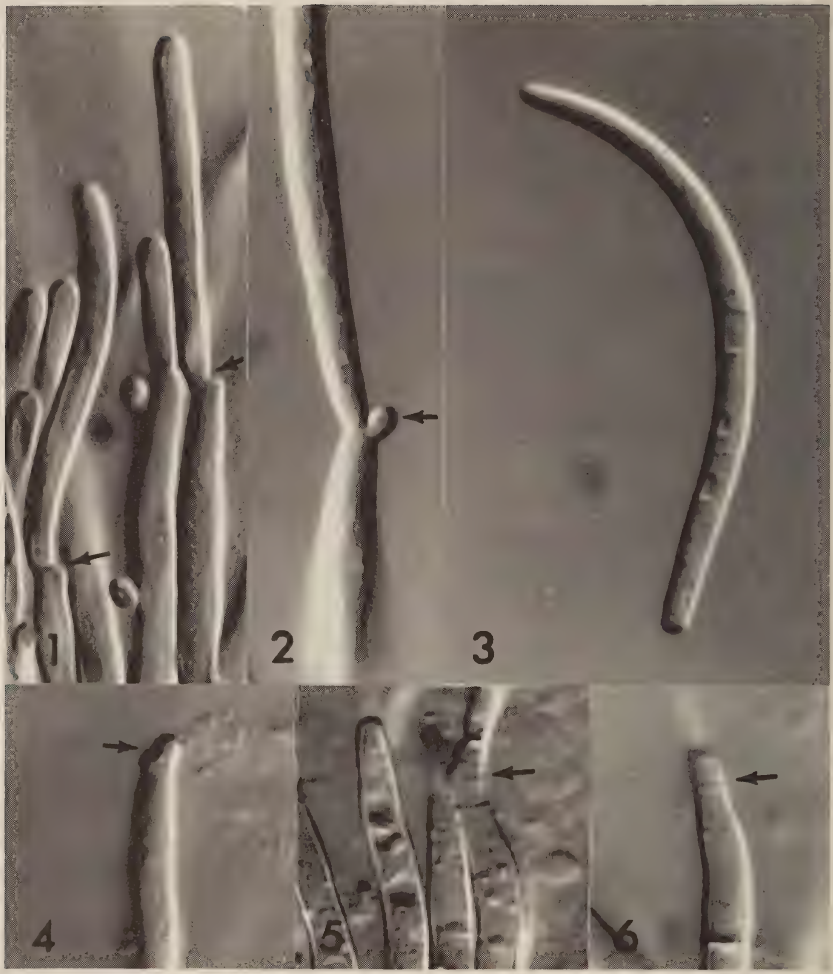
Previous studies have shown that species of Diatrypaceae often form anamorphs with both percurrently and sympodially proliferating conidiogenous cells (e.g., Glawe and Rogers, 1984; Abe, 1986; Glawe and Jacobs, 1987; Rappaz, 1987). Recently we obtained collections of Diatrypella prominens (Howe) Ell. & Everh. and Eutypella sabalina (Cooke) Ell. & Everh., and studied the anamorphs of these species. As detailed herein, anamorphs of both are typically diatrypaceous in their features of conidial and conidiomatal morphology, and conidiogenous cell proliferation.

Cultures were started as described previously (Glawe and Rogers, 1984), and maintained on Difco potato dextrose agar at 20 C under fluorescent light with a daylength of 10 h. Collections were deposited in ILLS.

Diatrypella prominens, anamorph, Figs. 1-6.

Anamorph on host not seen. Cultures covering 9-cm-diam culture plates in 14 days, producing conida in 30 days. One-month-old colonies white, cottony; reverse off-white to yellowish. Conidiomata pycnidial, composed of loosely woven dark hyphae; subconic, black, producing gray conidial masses. Conidiogenous cells cylindrical, tapering toward apex, proliferating sympodially (Figs. 1, 2, 4), percurrently (Figs. 5, 6), or both ways, (10.4-)12-18.4 (-19.2) X (1.6-)2-2.4 µm. Conidia hyaline, filiform, slightly to moderately curved (Fig. 3), with flat bases, 21.6-34.4 X 1.6-2.4 µm.

Collections from which cultures were started: Jones, J. P., 26.V.1986, Louisiana State University campus, Baton



Figs. 1-6. Anamorph of Diatrypella prominens in culture. 1. Conidiogenous cells with lateral succession scars (arrows) indicative of sympodial proliferation. 2. Conidiogenous cell with new conidium (arrow) developing to side of mature conidium. 3. Conidium. 4. Apical region of conidiogenous cell with lateral conidial succession scar (arrow) indicative of sympodial proliferation. 5, 6. Conidiogenous cells with annellations (arrows) indicative of percurrent proliferation. All X2500, by Nomarski differential interference contrast microscopy.

Rouge, East Baton Rouge Parish, Louisiana, on Platanus sp. Glawe, D. A. II.1987, West Washington Street, Urbana, Champaign Co., Illinois, on Platanus occidentalis L.

Eutypella sabalina, anamorph, Figs. 7-17.

Anamorph on host: Conidiomata immersed in host, pycnidial, multiloculate (Fig. 7), 0.6-0.8 mm diam, lined with palisades of conidiogenous cells. Conidiogenous cells arising from interwoven hyphae or pseudoparenchyma, cylindrical, tapering toward apex, proliferating sympodially (Figs. 8-10) or percurrently, 8.8-22.4 X 1.6-2.8 µm. Conidia hyaline, filiform, moderately to strongly curved (Figs. 11, 12), with flat bases, 12-17.6 X 0.8-1.2 µm. Cultures covering 9-cm-diam Petri plates in about 10 days, producing conidia in 19 days. One-month-old colonies white, felty, with gray to black areas of aerial hyphae. Conidiomata sporodochium-like, producing conidia in light-colored masses. Conidiogenous cells arising from interwoven hyphae or pseudoparenchyma, or borne on short, branched conidiophores arising from hyphae; cylindrical, tapering toward apex, proliferating sympodially (Figs. 13, 14) or percurrently (Figs. 15-17), 12-24 X 1.6-2.8 µm. Conidia hyaline, filiform, moderately to strongly curved, with flat bases, 12-20 X 1.2-1.6 µm.

Collection examined, and from which cultures were started: Jones, J. P., 17.II.1984, East Baton Rouge Parish, Louisiana, on Sabal minor (Jacq.) Pers.

Illinois Agricultural Experiment Station Project 68-312. We thank Drs. L. M. Carris and J. D. Rogers for reviewing the manuscript.

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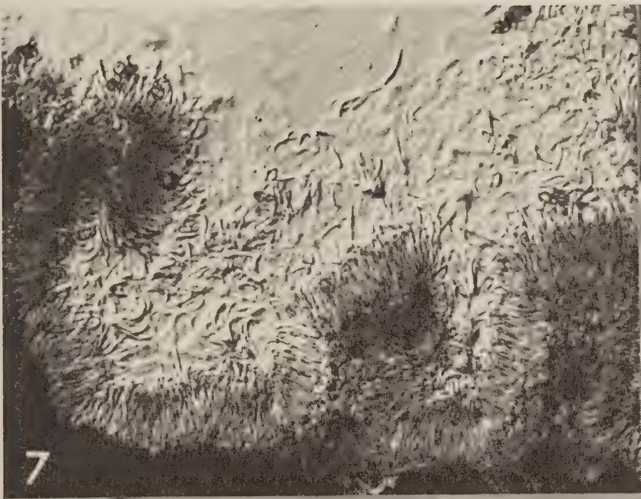
Figs. 7-17. Anamorph of *Eutypella sabalina*. 7-12. From host material. 7. Longitudinal section through conidioma showing palisades of conidiogenous cells lining locules, ca. X250. 8. Conidiogenous cell with lateral conidial succession scar (arrow) indicative of sympodial proliferation. 9, 10. Apical regions of conidiogenous cells with conidia (arrows) developing to the sides of mature conidia. 11, 12. Conidia. 13-17. From cultured material. 13. Apical region of conidiogenous cell with attached developing conidium. 14, 15. Conidiogenous cells with lateral conidial succession scars (arrows) indicative of sympodial proliferation. 16, 17. Conidiogenous cells with annellations (arrows) indicative of percurrent proliferation. All by Nomarski differential interference contrast microscopy, X2500 unless otherwise noted.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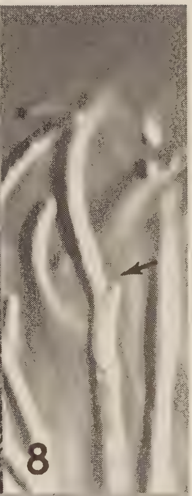
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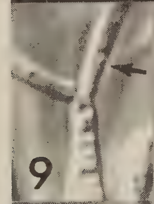
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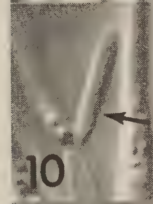
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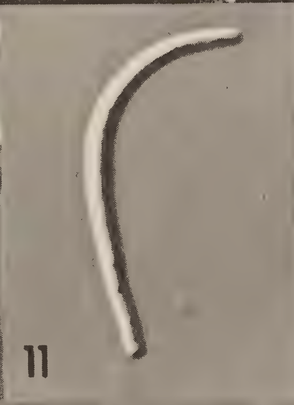
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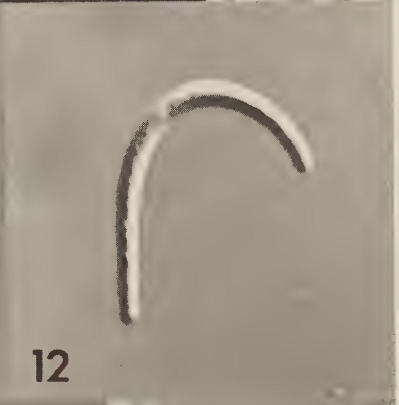
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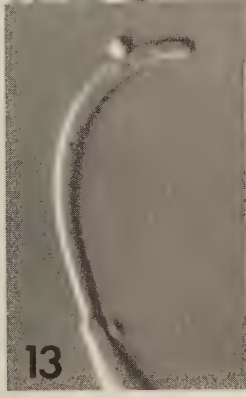
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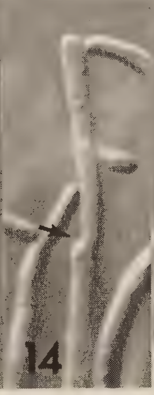
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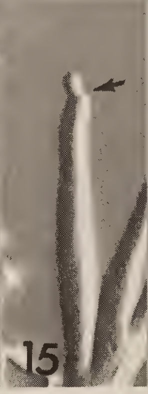
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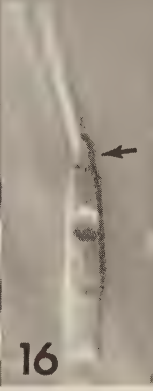
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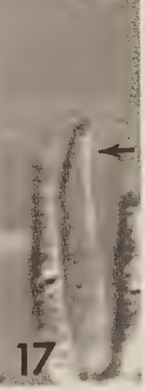
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A PRELIMINARY ACCOUNT OF XYLARIA OF MEXICO

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ABSTRACT

A preliminary account of *Xylaria* in México is presented, based primarily on collections from the states of Chiapas, Nuevo León, Quintana Roo, and Tamaulipas. The following new species are proposed: *X. alata*, *X. amphithele*, *X. claviceps*, *X. guazumae*, *X. magniannulata*, *X. scabriclavula*, *X. squamulosa*, and *X. uniapiculata*. A new variety, *tropica*, is proposed for *X. longipes*. In addition, nine taxa are discussed, but remain unnamed owing to condition or size of the pertinent collections. Several of these undoubtedly represent new species. In total, 63 taxa are described and represented in keys. Most of them are depicted among 155 figures.

Xylaria Hill ex Schrank is a cosmopolitan genus, reaching the zenith of its diversity in the various subtropical and tropical regions of the world. Until about 15 years ago it was widely considered that most of the species of *Xylaria* had been collected and were represented by specimens in various herbaria. Intensive collecting in Asian and American subtropics and tropics in recent years, however, has made clear that many taxa remain to be described. Indeed, *Xylaria* taxonomy has become vastly more complicated with the new additions from the tropics. For example, Rogers et al. (1988) published a treatment of *Xylaria* from Cerro de la

Neblina, Venezuela. Forty-one taxa were described from the rather small and circumscribed area, including 6 formally named new taxa and 9 additional potentially new taxa, i.e., about 37% of the taxa examined were unknown to the investigators. Dennis (1970) had presented keys to 47 taxa from Venezuela and adjacent countries. Roughly half of the taxa described by Rogers et al. (1988) were not included by Dennis (1970). Similar patterns are emerging elsewhere in the subtropics and tropics, including México.

The present study was initiated in 1986 by FSMG in examining xylariaceous fungi in the herbarium of Instituto Tecnológico de Ciudad Victoria (ITCV). He, his colleagues, and his students later collected extensively in the northeastern states of Nuevo León and Tamaulipas and the southeastern state of Quintana Roo and the south-southwestern state of Chiapas. These collections were brought to Washington State University in January, 1988 by FSMG where he spent the next three months in collaboration with JDR, thanks to financial support from USAID. In addition, JDR had previously examined about 80 specimens from herbarium XAL kindly provided by Gastón Guzmán. A substantial number of those specimens were immature and could not be identified with certainty. Those that were of use to this study have been cited herein and are denoted with an asterisk. Unfortunately, none of the FSMG or XAL material was in culturable condition. Current collecting in México, however, will emphasize the collection and preparation of specimens for culture studies.

We consider the present study to be preliminary. Nonetheless, 63 taxa are reported herein. Eight new species, one new variety, and 9 unnamed taxa are described and illustrated, i.e., 28% of the collections were unknown to us, following the experience of JDR with Venezuela material (see earlier herein). The only other study of Xylaria based exclusively on Mexican material, primarily herbarium specimens, is that of Pérez-Silva (1975) where 12 species were discussed. We have encountered every species discussed by Pérez-Silva except X. fockei (Miq.) Cooke. Comments on her concepts and data are included in the text.

It is premature to draw far-reaching conclusions about the distribution of Xylaria species in México. It is noteworthy, however, that X. longipes -- primarily a north temperate species -- was found in Tamaulipas state, a region where a mixing of northern and subtropical species is not unexpected, especially at higher altitudes. An atypical specimen of X. longipes was collected in the southern state of Chiapas and is considered by us to be a new variety. Other temperate to subtropical species encountered in the northern states are X. magnoliae, X. oxyacanthae, X. persicaria, and X. polymorpha. The former 3 species were collected largely from expected hosts or host families. On the other hand, basically subtropical or tropical species such as X. anisopleura are widespread in México as are representatives of the more cosmopolitan arbuscula complex.

It is noteworthy that representatives of various taxa show ostioles whitened by chemical deposits. It is assumed that such a condition arises under conditions of low relative humidity and/or high concentrations of certain minerals. It seems too widespread to be accorded taxonomic significance.

SPECIES WITH LARGE STROMATA ON WOOD*

(Stromata usually 5 mm or greater in diameter)

1. Stromatal surface more or less smooth 2
1. Stromatal surface more or less roughened with perithecial contours, coarse ostiolar papillae, wrinkles, or combinations of these features. 11

    2. Fertile part subglobose to oblong, blackish with white polygonal patches, becoming hollow, on narrow tomentose stipe, 3.5-5 cm total length X 4.5-5 mm diam. Ascospores (25-)29-33(-36) X 7-8(-9) μm, with abrupt pinched ends . . . . X. aff. comosa
    2. Combination of features differing from above .3

3. Fertile part subglobose to clavate, brown to dark-brown, becoming hollow and inrolled, on tomentose to smooth, attenuated stipe with discoid base, 2-6 cm total length X 5-10 mm diam, almost smooth with small wrinkles and prominent hemispherical ostioles. Ascospores 22-32(-35) X 6-8 μm, with ends abruptly pinched or rounded, and short, straight or oblique germ slit. . . . . X. cf. nigrescens

3. Combination of features differing from above. . . .4

4. Fertile part conical, on short to long, stout, pannose stipe, 1.8-6.8 cm total length X 0.4-3 cm diam; whitish to yellowish, with umbilicate or somewhat raised ostioles. Ascospores (19-)20-23(-25) X 8-9.5 (-10) µm, with broadly or narrowly rounded ends and spiralling germ slit. . . . . *X.* aff. *enterogena*

4. Fertile part cylindrical, clavate, or irregular 5

5. Stromata at first copper-colored, often blackening. 6

5. Stromata at first of another color. 8

6. Fertile part clavate on short stipe, 1.7-5 cm total length X 7-10 mm diam, often becoming hollow and inrolled, with finely papillate ostioles. Ascospores (7-)8-10(-11) X 4-5(-6) µm, the germ slit mostly not observed. . . . . *X. cubensis*

NOTE: What appears to be another form of this species has stromata with polygonal surface scales, bigger perithecia and ascospores 9-12 µm long.

6. Ascospore germ slits usually conspicuous, straight. Combination of other features differing from above. 7

7. Fertile part short clavate, on short or long stipe with pannose base, 1.6-2.3 cm total length X 4-6 mm diam, becoming hollow, with finely papillate ostioles. Ascospores (8.5-)9-11(-12) X 4-5 µm . . . . *X.* cf. *laevis*

7. Fertile part clavate to more or less cylindrical on short stipe, 5-8 cm total length X 1-1.5 cm diam, with finely papillate ostioles. Ascospores (9-)10-12 X 3.5-4 µm. . . . . *X. allantoidea*

---

* Ascospore germ slits may be assumed to be straight and oriented with the long axis of the spore and run essentially the length of the spore, unless noted otherwise in the key.

8. Fertile part clavate to irregular on short to obsolete stipe, 5.5-21 cm total length X 2-4 cm diam, at first whitish and smooth but becoming blackish and rugose on drying, with hemispherical ostioles. Ascospores 14-17(-18) X 5.5-6.5 µm . . . *X. poitei*
NOTE: Fungi with somewhat smaller stromata and larger ostiolar discs are referable to *X. guyanensis*. See description herein.

8. Fertile part generally smaller and less conspicuously wrinkled on drying. 9

9. Fertile part clavate-fusiform, on short to long stipe, yellowish to dull orange, up to 6.5 cm total length X 4-9 mm diam, becoming hollow prior to perithecial maturation, with umbilicate ostioles. Ascospores (17-)18-21(-22) X (5.5-)6-7 µm, with short, oblique germ slit . . . . *X. telfairii*

9. Fertile part 4-13 cm high, not usually fusiform. Ostioles and surface coloration making stromata appear conspicuously or weakly longitudinally striped. 10

10. Ascospores (9.5-)10-12(-12.5) X (4.5-)5-5.5 µm . . . . *X. grammica*
NOTE: Fungi with similar stromata and sterile apices have been called *X. venustula*.

10. Ascospores (27-)28-33.5(-35) X 6-7.5(-8) µm, with spiral germ slit. . . . . *X. kegeliana*

11. Ascospores usually 14 µm or longer. 12

11. Ascospores usually not longer than 14 µm 19

12. Fertile part clavate, compressed with sterile acute apices, on distinct stipe, 4-9 cm total length X 2-5 mm diam, blackish with brown scales or peeling outer layer, with papillate ostioles. Ascospores (15.5-)16.5-18(-20) X 6-7(-7.5) µm, with spiral germ slit . . . . *X.* cf. *corniculata*

12. Combination of features differing from above. 13

13. Fertile part broad clavate with rounded fertile apex, on long stipe, 10-11 cm total length X 1.5 cm diam, verrucose, black with white umbilicate to more or less hemispherical ostioles. Ascospores almost black, (12-)14-17(-18) X 6-7 μm, with acute to pinched ends. . . . . *X. pallide-ostiolata*

13. Features of stromata and ascospores different 14

    14. Fertile part cylindrical, clavate, or spathulate. 15

    14. Fertile part subglobose to ellipsoid 18

15. Fertile part cylindrical to clavate, on short to long stipe, 3.2-6.2 cm total length X 3-7 mm diam, blackish, becoming hollow, with conical or hemispherical ostioles often covered with whitish granules. Ascospores (13-)14-16 X 5-6 μm, with spiralling germ slit . . . . *X. longipes* var. *tropica* var. nov.

15. Fertile part similar to above, but with solid flesh and whitish to brown polygonal surface scales. 16

    16. Stromata 4-7 cm total length X 5-9 mm diam. Ascospores 13-16 X 4-5(-5.5) μm, with spiral germ slit. . . . . *X. longipes*

    16. Combination of features differing from above 17

17. Fertile part variable in shape, with short or long stipe and sometimes with long rooting base, 3-15 cm total length X 0.8-3 cm diam, blackish, roughened with wrinkles and verrucae, with inconspicuous to discoid ostioles. Ascospores (22-)23-26(-28) X 7.5-8(-9) μm, with short straight to oblique germ slit. . . . . *X. polymorpha*

    NOTE: A form of this species with long rooting base has been called *X. ophiopoda*.

17. Fertile part cylindrical, clavate, or irregular, on short or long tomentose stipe, 1.5-6 cm total length X 2-6 mm diam, blackish, sometimes with brown

scales, with inconspicuous to hemispherical ostioles. Ascospores 18-21 (-22) X 6-7 µm, with oblique to spiralling germ slit . . . . X. scruposa
NOTE: Some collections which might represent this species have prominent whitish hemispherical ostioles and ascospores (18-)19-25 X 6-8 µm with abruptly pinched ends and spiralling germ slits.

18. Fertile part subglobose to oblong-ellipsoidal, on short stipe, 1.5-2.5 cm total length X 0.5-1.6 cm diam, blackish, roughened by wrinkles and hemispherical ostioles. Ascospores 21-26 X (6-)6.5-8 µm, with short oblique germ slit . . . . X. schweinitzii
18. Fertile part subglobose to elongated, sessile or short stipitate, 0.3-5 cm total length X 0.1-1.2 cm diam, blackish, wrinkled and verrucose, with inconspicuous to hemispheric ostioles. Ascospores 22-30 (-31) X 7.5-9 µm, with short oblique to spiralling germ slit. . . . . . X. anisopleura

19. Fertile part cylindric-clavate to irregular with acute sterile apices, unbranched or branched, on short stipe, solitary or cespitose, 1.3-4 cm total length X 3-6 mm diam, exterior with brown scales, interior cream-yellow, with obscure to hemispherical ostioles. Ascospores (12-)12.5-14.5(-16) X 5-5.5 (-6) µm, with straight germ slit less than spore length. On monocot . . . . Xylaria sp. (no. 303)
19. Combination of features differing from above. Stromata on dicot wood. 20

20. Fertile part cylindrical to irregular, usually branched, on distinct stipe, sometimes with discoid pannose base, solitary, 2.5-5.5 cm total length X 2-6 mm diam, brown to dark brown, strongly roughened with papillate ostioles. Ascospores 9-10(-11) X (3.5-)4 µm,

with hyaline cellular appendage at one end. . . . . *X. uniapiculata* sp. nov.

20. Combination of features differing from above 21

21. Fertile part cylindrical, the uppermost portions often flattened, unbranched or branched, solitary, on short to long stipe, 7-10 cm total length X 3-12 mm diam, reddish brown to dull black, ornamented by reticulating cracks, with small papillae often surrounded by sunken discs. Ascospores (9.5-)10.5-13 (-14) X 4-5(-5.5) µm, with straight germ slit slightly less than spore-length . . . . *X. adscendens*

21. Combination of characters differing from above 22

22. Fertile part clavate, about ¼ total length, on long stipe originating from swollen base, unbranched or branched, 7-8 cm total length X 5-7 mm diam, blackish, with gray peeling layer, with whitish deposits surrounding papillate ostioles. Ascospores (8-)8.5-9(-10) X 4-5 µm, nearly black, with inconspicuous germ slit . . . . *X. claviceps* sp. nov.

22. Stromata with short stipes. 23

23. Fertile part clavate, spathulate, or irregular, branched or unbranched, from pannose base, 2.5-6.5 cm total length X 5-10 mm diam, black, rugulose, with finely papillate to discoid ostioles. Ascospores (8-)8.5-11(-12) X 4-4.5(-5) µm, with germ slit conspicuous or inconspicuous . . . . . . *X. feejeensis*
NOTE: Fertile part sometimes hollow, with ostioles covered by a white material.

23. Fertile part clavate to cylindrical, unbranched or branched, 1.5-3.5 cm total length X 2.5-5 mm diam, blackish with whitish to yellowish scales, rugulose, with obscure to finely papillate ostioles. Ascospores (9.5-)10-11

X 4-4.5 μm, with straight germ slit sometimes slightly less than spore-length . . . . *X*. cf. *curta*

SPECIES WITH SMALL STROMATA ON WOOD OR SOIL*
(Stromata usually less than 5 mm diameter)

1. Stromatal surface more or less smooth 2
1. Stromatal surface more or less roughened with perithecial contours, coarse ostiolar papillae, wrinkles, or combinations of these features 9

    2. Fertile part fusoid or short cylindrical with acute sterile apices, with inconspicuous to conspicuous perithecial contours, on very long filiform tomentose stipe ca. 3/4 total length, solitary or branched, 7.5-7.8 cm total length X 1-2 mm diam, black with dark brown peeling outer layer, with inconspicuous to more or less papillate ostioles. Ascospores 11-14(-16) X 5-6 μm . . . . *X*. *brachiata*
    2. Fertile part various. Stipe short, not filiform 3

3. Fertile part subglobose to elongated, up to 6 mm long X 4 mm diam, on narrow stipe 1-1.5 cm long, solitary, blackish gray with whitish scales, with inconspicuous ostioles. Ascospores (29-)31-37 (-40) X (11-)12-13(-14) μm, with hyaline sheath. . . . . *X*. *squamulosa* sp. nov.
3. Fertile part clavate, cylindrical, conical, or irregular 4

    4. Stroma light-colored or white 5
    4. Stroma brown to dark brown or black 6

5. Fertile part cylindrical on short or long stipe 0.5-3.5 cm total length X

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* Ascospore germ slits may be assumed to be straight and oriented with the long axis of the spore and run essentially the length of the spore unless noted otherwise in the key.

1-3 mm diam, with white granular material over much of clava, with black umbilicate or slightly raised ostioles. Ascospores 6-9(-10) X 3-3.5(-4) μm, with inconspicuous germ slit . . . . X. "muscula"

5. Fertile part clavate, conical to subglobose on long stipe, 1.5-3.5 cm total length X 3-5 mm diam, at first white becoming cinereus, very smooth and hard, with discoid ostioles. Ascospores (8.5-)9-10(-11) X 3.5-4.5 μm, with inconspicuous germ slit . . . . X. pallida

6. Fertile part cylindrical on distinct stipe, with acute sterile apices, slightly to strongly pubescent overall, unbranched or branched, 3 cm total length X 1-2 mm diam, black with brown peeling outer layer, with umbilicate to slightly papillate ostioles. Ascospores 11-12(-12.5) X (4-)5-5.5 μm, with germ slit less than spore-length . . . . X. maitlandii

6. Fertile part glabrous. 7

7. Fertile part cylindrical with more or less flattened sterile apices, on short stipe, 1-2.5 cm total length X 2-4 mm diam, with reddish brown to dark brown peeling outer layer, with slightly raised ostioles in small disc. Ascospores (9-)9.5-11(-12) X 4(-4.5) μm . . . . Xylaria sp.(nos. 39,306)
NOTE: This species also is found on soil, probably associated with insect nests.

7. Combination of characters differing from above. 8

8. Fertile part cylindrical to long-conical on obsolete or short to long glabrous or pubescent stipe, 0.6-3.5 cm total length X 1-4 mm diam, blackish with gray to brown peeling outer layer splitting in bands, with umbilicate to slightly papillate ostioles. Ascospores (12-)13-18(-19) X (4-)4.5-6 μm,

with straight to undulate germ slit 1/2 to 3/4 spore-length . . . . *X. arbuscula*

NOTE: Some collections probably referrable to this species are more robust and have strigose stipes.

8. Fertile part cylindrical to clavate, with more or less acute sterile apices, on short to long pubescent stipe, unbranched or branched, solitary to cespitose, 1-5.5 cm total length X 1-2 mm diam, blackish with brown peeling outer layer, undulate from perithecial contours, with more or less punctate ostioles. Ascospores 9-11(12-) X (3.5-)4-4.5 (-5) µm . . . . *X. multiplex*

9. Stromata growing on soil (or wood, nests, seeds etc. buried in soil) 10
9. Stromata growing on wood. 12

10. Fertile part of more or less naked perithecia on short or long filiform tomentose rachis, with long or short sterile apex, 3-12 cm total length X 1-3 mm diam, blackish, with papillate ostioles. Ascospores 10-12(-13) X 4-5 µm, with straight germ slit less than spore-length. . . . . *X. gracillima*
10. Fertile part bearing more or less immersed perithecia. 11

11. Fertile part cylindrical with sterile apex, on tomentose stipe, unbranched, solitary, 3-5.5 cm total length X 1-2 mm diam, blackish with gray peeling outer layer, with conical ostioles. Ascospores with flattened hyaline cellular appendage at each end, 8-10 X 3-4 µm (including appendages) . . . . *X. alata* sp. nov.
11. Fertile part cylindrical with sterile apices, branched or unbranched, on short to long tomentose stipe, 4 cm total length X 1.5-3 mm diam, blackish with brownish to gray outer layer, with prominent conical ostioles. Ascus with massive apical ring. Ascospores 34-45(-47) X (14-)15-20(-21) µm, with

hyaline noncellular appendages and hyaline sheath. . . . . . *X. magniannulata* sp. nov.

12. Stromata growing on monocot wood 13
12. Stromata growing on dicot wood 14

13. Fertile part more or less clavate, on short stipe, 1 cm total length X 1.5-3 mm diam, reddish brown, very rough, with hemispherical ostioles. Ascospores 10-12(-14) X 3.5-4.5(-5) µm, with germ slit less than spore-length. . . . . *X. scabriclavula* sp. nov.
13. Fertile part cylindrical, with more or less crowded naked perithecia, with acute sterile apex, on more or less short stipe from swollen base, 1.5-4 cm total length X 1-2 mm diam, blackish with brown peeling outer layer, with small papillate ostioles, sometimes within a depressed annulus. Ascospores (10.5-)11-12 X 3-4 µm, with germ slit obscure or perhaps absent . . . . *Xylaria* sp., aff. *bambooensis*

14. Fertile part bearing more or less immersed to conspicuous perithecia, the prominence of perithecial contours often varying on different parts of the same stroma. 15
14. Fertile part bearing more or less naked individual perithecia or clusters of naked perithecia. 24

15. Fertile part cylindric-compressed bearing immersed to almost naked perithecia, with acute sterile apex, unbranched or branched, on more or less short stipe, up to 7 cm total length X 2-4 mm diam, dull blackish, tomentose over all, with finely papillate ostioles. Ascospores 10-13(-14) X (2.5-)3-4 µm, subhyaline, without evident germ slit . . . . . *X.* cf. *dichotoma*
15. Fertile part glabrous 16

16. Fertile part cylindrical to spathulate with acute sterile apex on long, pubescent stipe, solitary

or cespitose, usually branched, 2.5-3 cm total length X 1-6 mm diam, blackish with white peeling outer layer, with conical to hemispherical ostioles. Ascospores (10-)11-13(-14) X 4-5(-6) µm, with spiral germ slit . . . . *Xylaria* sp., aff. *arbuscula* (no. 202)

16. Fertile part without conspicuous peeling outer layer or, if present, dark brown or blackish 17

17. Fertile part cylindrical, with sterile acute apex, on ill-defined stipe, solitary or cespitose, 2-6 cm total length X 2-4 mm diam, black although apex often with white remains of anamorph, with somewhat raised ostioles. Ascospores (7.3-)9-10(-11) X 4-5(-5.5) µm . . . . *X.* cf. *longiana*

17. Combination of features differing from above. . . 18

18. Fertile part cylindrical to clavate with blunt to acute sterile apex, on more or less long stipe, unbranched or branched, 1-5 cm total length X 1-3 mm diam, blackish with lighter brown peeling outer layer, with conspicuous crowded hemispherical ostioles. Ascospores 8-9(-10) X 4.5-5 µm, some with hyaline cellular appendage on one end. . . . . *Xylaria* sp.(nos. 38, 64)

18. Combination of features differing from above 19

19. Fertile part cylindrical, on short stipe, 7-10 mm total length X 1-3 mm diam, blackish with brown peeling outer layer, with circumferentially-oriented wrinkles, with white fringed, strongly conical ostioles. Ascospores (11-)13-14(-15) X 4-5 µm, with germ slit obscure . . . . *Xylaria* sp. (no. 359)

19. Combination of features differing from above. 20

20. Fertile part cylindrical to clavate, with sterile apex, on short stipe originating from bulbous base, ca. 2 cm total length X 2-3 mm diam, blackish, with finely papillate ostioles. Ascospores 10-11 X 3.5-4 µm . . . . X. cf. brevipes

20. Combination of features differing from above 21

21. Fertile part short-cylindric to clavate 22

21. Fertile part cylindrical to irregular 23

22. Fertile part cylindrical with acute sterile apex, originating from tomentose discoid base, solitary, 1.5-3 cm total length X 1.5-3 mm diam, black with inconspicuous brown to dark brown peeling outer layer, with conical to hemispherical ostioles. Ascospores (8.5-)9-11 X (3-)3.5-4(-4.5) µm, with straight germ slit less than spore-length . . . . Xylaria sp. (no. 729)

22. Fertile part cylindrical to cylindric clavate, on more or less long stipe, 1.5-2 cm total length X 1-2 mm diam, blackish with brown to dark brown peeling outer layer, with papillate ostioles. Ascospores 9-10(-11) X (4-)4.5-5 µm, without obvious germ slit. . . . . Xylaria sp.(no. 372)

23. Fertile part unbranched or branched, on short to long stipe, 1.5-3.5 cm total length X 2.5-4 mm diam, blackish with peeling outer layer, with hemispherical ostioles. Ascospores 9-10(-11) X 4-4.5 (-5) µm . . . . Xylaria sp. aff. feejeensis (no. 47)

23. Fertile part unbranched or branched, roughened with perithecial undulations, with attenuated sterile apex, on short to long stipe, 1.5-3.5 cm total length X 2-3 mm diam, black and lacking outer peeling layer, with inconspicuous conical ostioles. Ascospores 9-10.5(-11) X 4-5 µm, with straight germ slit less than spore-length. . . . . Xylaria sp.(no. 331)

24. Ascospores usually longer than 12.5 µm. 25
24. Ascospores usually no longer than 12.5 µm 26

25. Fertile part cylindrical, terete or compressed or irregular, with attenuated sterile apex, on long stipe, 1.5-3 cm total length X 1 mm diam, blackish, with grey peeling outer layer, pubescent over all, with umbilicate to slightly raised ostioles. Ascospores 14.5-17(-18) X 5-5.5(-6.5) µm, with straight germ slit slightly less than spore-length . . . . *X. juruensis*
25. Fertile part cylindrical, with sterile apex, on long stipe, unbranched or branched, 3-5 cm total length X 2-3 mm diam, with outer peeling brown layer, with umbilicate or finely papillate ostioles. Ascospores (12.5-)13-16(-18) X 5-6 µm. . . . . *X.* cf. *mellisii* var. *nuda*

26. Fertile part cylindrical with sterile apex, on short to long stipe, unbranched or branched, 1.5-6 cm total length X 1-3 mm diam, blackish covered with white, yellowish, or brownish peeling outer layer, with slightly raised ostioles. Ascospores 10-11(-13) X (3.5-)4-4.5 µm, with straight germ slit less than spore-length . . . . *X. coccophora*
26. Fertile part cylindrical with long acute sterile apex, on short glabrous stipe, unbranched, 1.5-3 cm total length X 2 mm diam, blackish with white peeling outer layer, with slightly raised ostioles. Ascospores (9-)10-11 X 4-4.5(-5) µm, with straight germ slit less than full spore length. . . . . . *X.* cf. *microceras*

SPECIES ON LEAVES, PETIOLES, OR FRUITS*

1. Stromata on fruits. 2
1. Stromata on leaves or petioles. 9

2. Fertile part globose to somewhat conical 3

2. Fertile part cylindrical, clavate, or irregular 4

3. Fertile part composed of a head of more or less naked perithecia on long rachis that becomes the stipe, 3.7-5 cm total length X 1-2 mm diam, black, with conical ostioles. Ascospores (14-)15-18(-19) X 5.5-6 μm, with hyaline noncellular appendage at each end, with straight germ slit slightly less than spore-length. On *Guazuma ulmifolia* fruits. . . . . *X. guazumae* sp. nov.

3. Fertile part composed of a globose to somewhat conical head with nearly immersed to evident perithecia on long finely pubescent stipe, 1-1.6 cm total length X 0.8-2 mm diam, at first white becoming grayish, with papillate ostioles. Ascospores 9-10(-11) X (3.5-)4-4.5 μm, with straight germ slit 3/4 spore-length. On *Guazuma ulmifolia* fruits. . . . . *X. aristata*

4. Ascospores usually longer than 12 μm. 5

4. Ascospores no longer than 12 μm. 7

5. Fertile part cylindrical to irregular, with scattered to crowded, more or less naked perithecia, with acute sterile apices, on short to long tomentose stipe, 4-7 cm total length X 1.5-3.5 mm diam, dark brown to black, with conical ostioles. Ascospores 12-16(-17) X 3-5 μm, subhyaline to yellowish, without evident germ slit. On *Magnolia schiedeana* fruits. . . . . *X. magnoliae*

5. Fertile part and ascospores differing from above. .6

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* Ascospore germ slits may be assumed to be straight and oriented with the long axis of the spore and run essentially the length of the spore, unless otherwise noted in the key.

6. Fertile part cylindrical with scattered to crowded, more or less evident perithecia, with sterile apices, on short to long tomentose stipe, 3.5-7 cm total length X 0.5-2 mm diam, with conical ostioles. Ascospores 13.5-16 X (4.5-)5-6(-6.5) µm, with spiral germ slit. On *Liquidambar styraciflua* fruits . . . . *X. persicaria*

6. Fertile part cylindrical to somewhat conical, with sterile apices, on short or long glabrous or pubescent stipe, 0.3-2.2 cm total length X 1.5-2.5 mm, blackish with gray peeling outer layer, with slightly raised ostioles. Ascospores (12-)13-16 X 4.5-6 µm, with straight to undulate germ slit 1/2 to 3/4 spore-length. On *Swietenia macrophylla* and *Quercus* spp. fruits . . . . *X. arbuscula*
   NOTE: *X. arbuscula* is more commonly encountered on wood. It is also keyed out with the small wood-inhabiting species.

7. Fertile part irregular in shape, compressed, branched, bearing more or less naked perithecia, on long finely pubescent stipe, 2 cm total length X 1.5 mm diam, blackish, with umbilicate to slightly raised ostioles. Ascospores 10-11(-11.5) X 4-4.5(-5) µm. On *Swietenia macrophylla* fruit . . . . *X.* cf. *inaequalis*

7. Combination of features differing from above. 8

8. Fertile part cylindrical to irregular, bearing more or less naked perithecia, with acute sterile apex, unbranched or branched, usually on ill-defined stipe, 2-13 cm total length X 1.5-2.5 mm diam, reddish brown to blackish, tomentose overall, with finely papillate ostioles. Ascospores 10-12(-13) X 4-5 µm. On fruits of *Guazuma ulmifolia* and various pods, including *Pithecellobium flexicaule* . . . . *X. ianthino-velutina*

8. Fertile part cylindrical with short sterile apex on long tomentose stipe, 3-7 cm total length X 1-2.5 mm diam, blackish with grayish brown peeling outer layer splitting in lines, with papillate ostioles. Ascospores (9.5-)10-11.5(-12) X 5-5.5 µm. On buried fruits and superficial unidentified pods. . . . . X. oxyacanthae

9. Fertile part globose. 10

9. Fertile part more or less cylindrical 11

10. Fertile part a small aggregation of more or less naked perithecia on rachis that often extends into a sterile apex, on long, glabrous stipe, up to 2 cm total length X 1-2.5 mm diam, black, with barely papillate ostioles. Ascospores 12-14(-15) X (6-)7-8 µm, with hyaline noncellular appendage at each end . . . . X. amphithele sp. nov.

10. Fertile part globose with immersed perithecia, with acute sterile apex, on long stipe, up to 2.3 cm total length X 1.5 mm diam, with stipe and sterile apex tomentose, with papillate to almost digitate ostioles. Ascospores 10-12(-14) X 5-6 µm, with hyaline cellular appendage at one end. . . . . Xylaria sp. (no. 337)

11. Fertile part short cylindrical, composed of aggregations of more or less naked perithecia, with acute sterile apex, on filiform glabrous stipe, 0.5-1.3 cm total length X 0.5-1.5 mm diam, black, with papillate ostioles. Ascospores (5.5-)6-7 X 3-3.5(-4) µm, with straight germ slit slightly less than spore-length . . . . Xylaria sp. (no. 211)

11. Fertile part cylindrical, bearing immersed perithecia, with short, acute sterile apex, on more or less long stipe, 0.3-3.8 cm total length X 0.5-

1.5 mm diam, reddish brown, with strongly papillate ostioles. Ascospores 11-14 X 5-6(-7) μm, with hyaline sheath, with straight germ slit slightly less than spore-length . . . . *X. phyllocharis*

Xylaria adscendens (Fr.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 128. 1851. Figs. 1,2.

Stromata unbranched or branched from the base or above, cylindrical, terete or flattened particularly in apical parts, with apices sterile, on short or long stipes, 7-10 cm total length X 3-12 mm diam; externally reddish brown to dull black; internally whitish, sometimes becoming hollow. Texture hard. Surface smooth, ornamented with reticulating cracks. *Perithecia* 0.4-0.8 mm diam. Ostioles papillate, often located in sunken circular areas 0.25-0.35 mm diam. *Asci* eight-spored, cylindrical, long-stipitate, 230-255 μm total length X 6-6.5 μm broad, the spore-bearing part 72-84 μm, with apical ring bluing in Melzer's iodine reagent, quadrate, 2 X 2 μm. *Ascospores* brown, unicellular, ellipsoid-inequilateral with broadly or narrowly rounded ends, smooth, (9.5-)10.5-13(-14) X 4-5(-5.5) μm, with straight germ slit slightly less than spore-length.

SPECIMEN EXAMINED: García 5249, 22.VIII.1986 and San Martín 203, 18.VII.1987, "El Cielo" ranch, Gómez Farías municipality, Tamaulipas state, on *Quercus* spp. wood in cloud forest.

NOTES: Our material seems much like that described and illustrated by Dennis, 1961; Rogers, 1984A. Ascospores and the ascus are depicted in Rogers (1984A).

Xylaria alata San Martín & Rogers, sp. nov. Figs. 3,4, 117-122.

Stromata cylindracea, aggregatis peritheciis plus minusve immersis, apicibus acutis sterilibus, in longis abrupte attenuatis tomentosis stipitibus, 3-5.5 cm longa X 1-2 mm crassa; extus nigella cum externo strato cinereo delapso; intus albida vel flavida. Textura mollis vel plus minusve dura. Superficies asperata ab formis peritheciorum et papillis ostiolorum. Perithecia 0.2-0.3 mm diam. Ostiola conica. Asci saepe biseriate octospori, cylindrici, stipitati, 76-110 longitudine tota

X 4-7 μm crassi, partibus sporiferis 44-60 μm, annulo apicali in liquore Melzeri cyanescente, quadrato, 1.5-2 μm X 1.5-2 μm. Asci inter conspicue crassas paraphyses. Ascosporae brunneae, ellipsoideo-inequilaterales, omni extremo cum cellulari appendicula complanata hyalina ca. 2 μm X 2 μm, leves, 8-10 X 3-4 μm includentes appendiculas, rima germinative recta per longitudinem partis coloris sporae. Anamorphosis ignotus.

Stromata cylindrical, with crowded partially immersed perithecia, with acute sterile apices, on abrupt, long thin tomentose stipes, 3-5.5 cm long X 1-2 mm diam; externally blackish with gray peeling outer layer; internally whitish to yellowish. Texture soft to fairly hard. Surface roughened with perithecial contours and ostiolar papillae. Perithecia 0.2-0.3 mm diam. Ostioles conical. Asci eight-spored, the spores arranged in a uniseriate or partly biseriate manner, cylindrical, stipitate, 76-110 μm total length X 4-7 μm broad, the spore-bearing part 44-60 μm, with apical ring bluing in Melzer's iodine reagent, quadrate, 1.5-2 μm X 1.5-2 μm. Asci among conspicuously broad paraphyses. Ascospores brown, ellipsoid-inequilateral with a flattened hyaline cellular appendage ca. 2 μm X 2 μm at each end, smooth, 8-10 X 3-4 μm including appendages, with straight germ slit running the length of the colored part of the spore. Anamorph unknown.

SPECIMEN EXAMINED: San Martín 389, VI.1987, Gómez Farías, Tamaulipas state, on wood or fruits buried in soil in median subdeciduous rain forest (HOLOTYPE:ITCV).

NOTES: This fungus differs from all other Xylarias in the wing-like flattened ascospore appendages. It is named on the basis of these ascospore "wings." Cellular appendages on ascospores of most Xylarias are essentially conical, i.e., appearing approximately the same shape as the spore is rotated. The appendages of X. alata appear conical in some orientations and plate-like in others, i.e., as if one were rotating the bit of a spade or spatula. They sometimes curl upward. The centrum of

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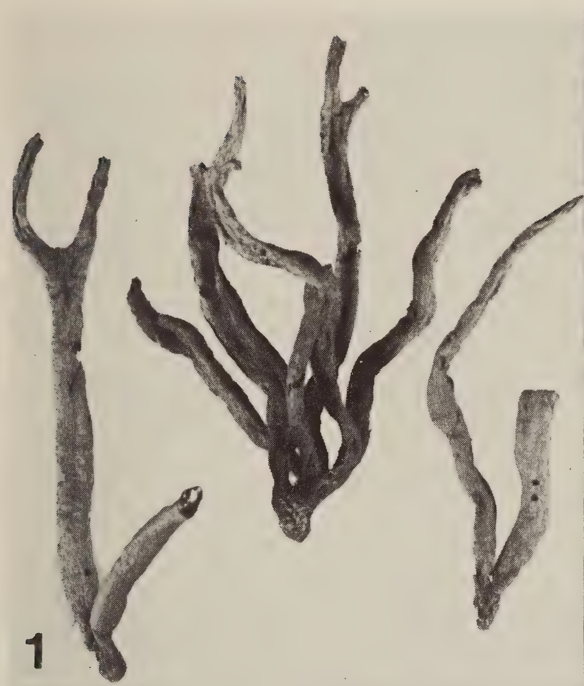
Figs. 1-5. 1,2. Xylaria adscendens. 1. Stromata, X 0.85. 2. Stromatal surface, X 16. 3,4. Xylaria alata. 3. Stromatal surface, X 16. 4. Stromata, X 2. 5. Xylaria allantoidea. Stromata, X 1.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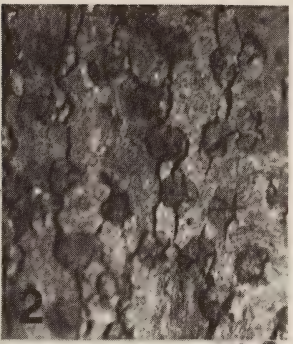
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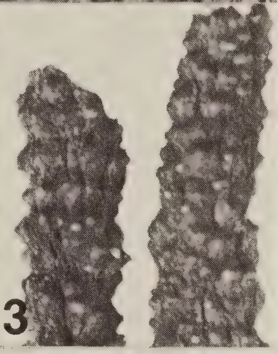
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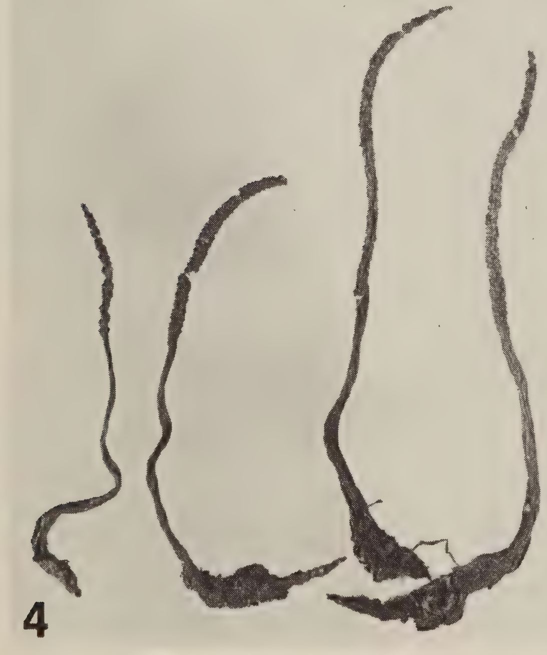
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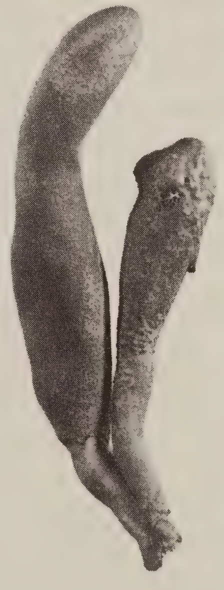
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this fungus is noteworthy in having very broad paraphyses for the small size of the perithecium. They are much larger than mature asci.

Xylaria allantoidea (Berk.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 127. 1851. Figs. 5,9.

Stromata unbranched or branched at base, clavate to clavate-cylindric, with rounded fertile apices, on short stipes, 5-8 cm total length X 1-1.5 cm diam, externally copper- to bronze-colored, becoming black; internally white to yellowish, becoming hollow. Texture hard. Surface smooth except for ostiolar papillae. Perithecia 0.5-1 mm diam. Ostioles finely papillate. Asci eight-spored, the spores arranged in a uniseriate or partially biseriate manner, cylindrical, 150-180 μm total length X 4-5 μm broad, the spore-bearing part 72-88 μm long, with apical ring bluing in Melzer's iodine reagent, quadrate, 2 X 2 μm. Ascospores light brown to brown, unicellular, ellipsoid-inequilateral, smooth, (9-)10-12 X 3.5-4 μm, with germ slit straight, somewhat less than spore-length.

SPECIMENS EXAMINED: *Brown, D. 576, 19.VIII.1982, Parque Francisco Javier Clavijero, INIREB, near Xalapa-Coatepec, Veracrúz state, on wood (JDR;XAL); Guevara 730, 31.I.1986, between Plan de la Noria and San Isidro, José María Morelos municipality, Quintana Roo state, on wood (ITCV).

NOTES: Our material seems typical for the species (see Dennis, 1956; Rogers, 1984B).

Xylaria amphithele San Martín & Rogers, sp. nov. Figs. 6,113,115,116.

Stromata globosa vel conica, constantia ex aggregatis 3-4 vel 20 peritheciorum nudorum 1-2.5 mm diam, interdum sterilibus appendicibus ornata, in longis attenuatis glabris stipitibus usque ad 2 cm longitudine; extus nigella; intus alba. Textura mollis. Superficies capituli

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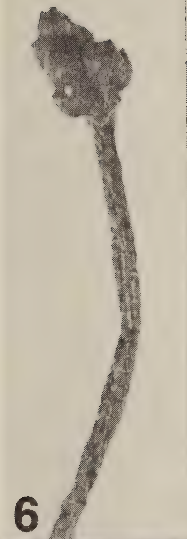
Figs. 6-12. 6. Xylaria amphithele. Stroma, X 10. 7,8. Xylaria anisopleura. 7. Stromata, X 3. 8. Stromatal surface, X 16. 9. Xylaria allantoidea. Stromatal surface, X 16. 10-12. Xylaria arbuscula. 10. Stromata, X 1.5. 11. Stromatal surface, X 16. 12. Stromata, X 1.25.



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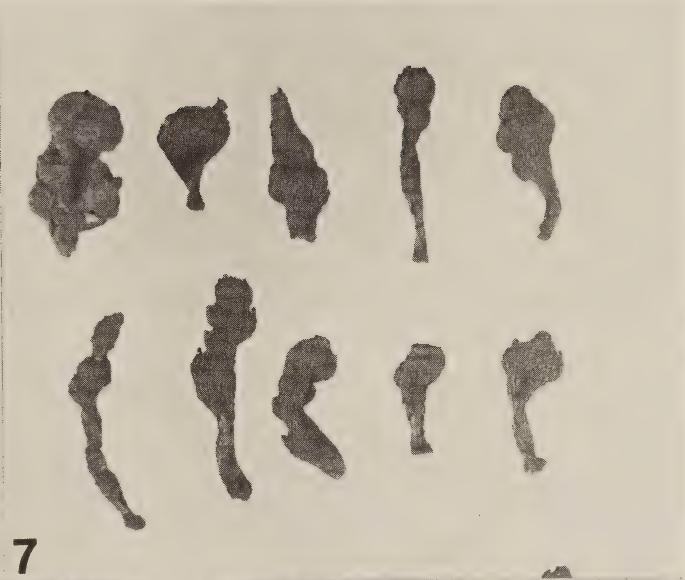

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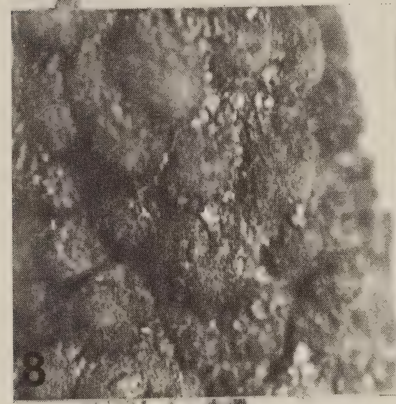

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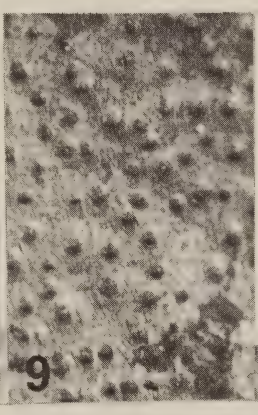

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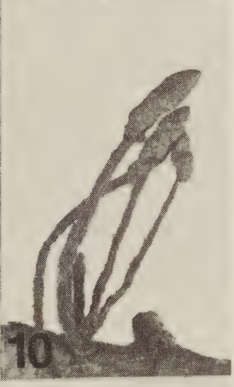

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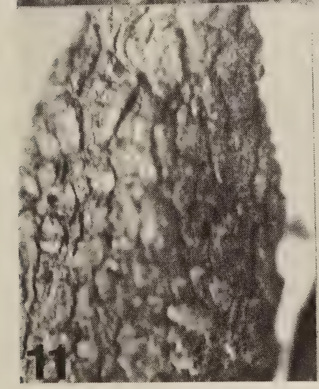

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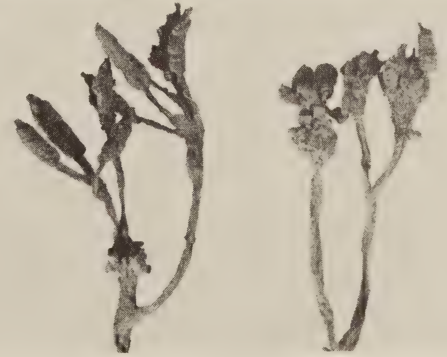

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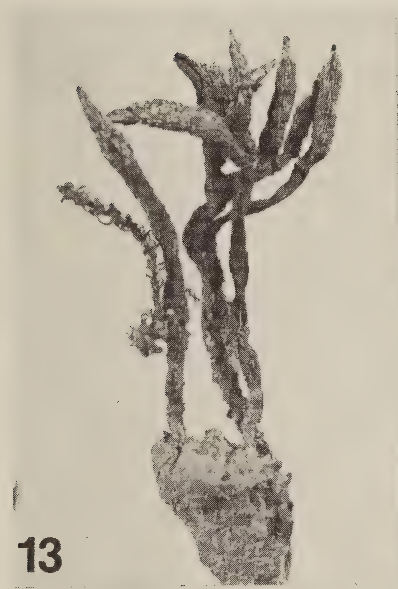
asperata a formis peritheciorum. Perithecia 0.3-0.5 mm diam. Ostiola plus minusve papillata. Asci octospori, cylindrici, stipitati, 129-175 µm longitudine tota X 9.5-11 µm crassi, partibus sporiferis 79-102 µm, annulo apicali in liquore Melzeri cyanescente, inverse petasiformis, 3.5-4.5 µm alto X 2.5-3 µm crasso. Ascosporae brunneae, unicellulares, ellipsoideo-inaequilaterales cum rotundatis extremis, omni extremo cum cylindracea vel globosa hyalina noncellulari appendicula 2-5 µm longa X 5 µm crassa, leves, parte colorata 12-14(-15) X (6-)7-8 µm, rima germinativa recta per longitudinem sporae. Status anamorphosis ignotus.

Stromata globoid to conical, composed of aggregations of 3-4 to 20 naked perithecia 1-2.5 mm diam, sometimes with sterile apiculi, on long thin glabrous stipes up to 2 cm long; externally dull black; internally white. Texture soft. Surface of head roughened with perithecial contours. Perithecia 0.3-0.5 mm diam. Ostioles barely papillate. Asci eight-spored, cylindrical, stipitate, 129-175 µm total length X 9.5-11 µm broad, the spore-bearing part 79-102 µm, the apical ring bluing in Melzer's iodine reagent, inverted hat-shaped, 3.5-4.5 µm high X 2.5-3 µm broad. Ascospores dark brown, unicellular, ellipsoid-inequilateral with rounded ends each bearing a cylindrical to globular hyaline noncellular (secondary) appendage 2-5 µm long X 2-5 µm broad, smooth, the colored part 12-14(-15) X (6-)7-8 µm, with straight germ slit full-length. Anamorph unknown.

SPECIMEN EXAMINED: San Martín 207, VII.1987, Gómez Farías, Tamaulipas state, on dried fallen leaves in median subdeciduous rain forest (HOLOTYPE:ITCV; ISOTYPE:JDR).

NOTES: This curious little Xylaria is unlike any species known to us. It is named on the basis of the ascospore appendages, i.e., the two nipples.

Figs. 13-20. 13,14. Xylaria sp. aff. arbuscula. 13. Stromata, X 1.5. 14. Stromatal surface, X 16. 15,16. Xylaria sp. (SM 337). 15. Fertile head, X 14. 16. Stromata, X 2.25. 17,18. Xylaria sp. aff. bambooensis. 17. Stromata, X 2.25. 18. Stromatal surface, X 16. 19,20. Xylaria cf. brevipes. 19. Stromatal surface, X 16. 20. Stromata, X 1.8.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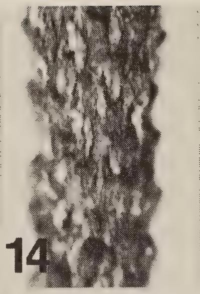
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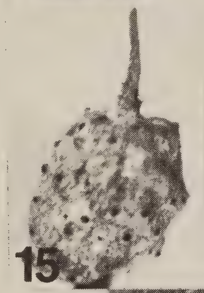
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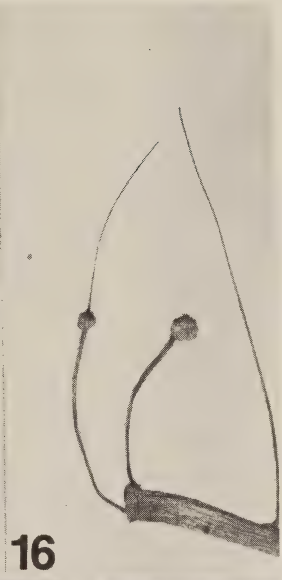
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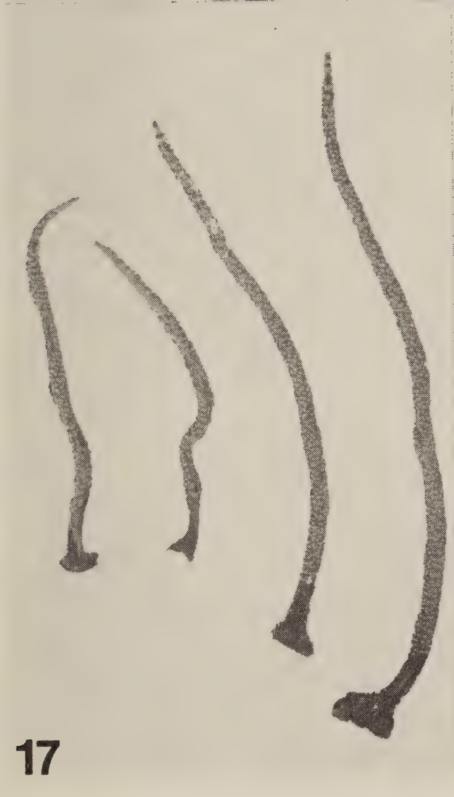
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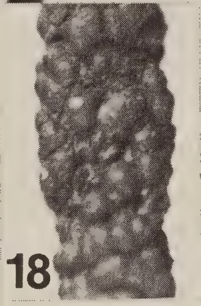
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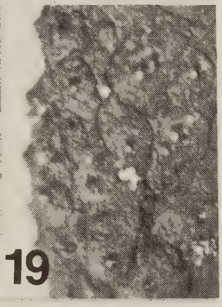
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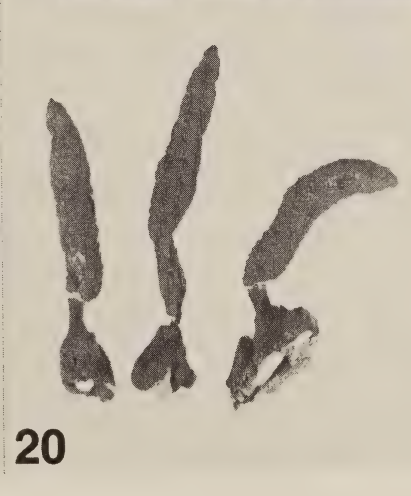
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Xylaria anisopleura (Mont.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 127. 1851. Figs. 7,8.
X. globosa (Spreng.: Fr.) Mont., Ann. Sci. Nat. Bot. (sér. 4) 3:103. 1855, fide Laessøe in litt.

Stromata unbranched or branched, subglobose to elongated or irregular, often moriform, sessile or stipitate, 0.3-5 cm total length X 0.1-1.2 cm diam; externally dull black; internally white to yellowish. Texture cheesy to woody. Surface usually roughened with wrinkles, verrucae, ostiolar papillae and, occasionally, tomentum. Perithecia 0.3-1 mm diam. Ostioles obscure to hemispherical. Asci eight-spored, stipitate, 230-275 µm total length X 8-10 µm broad, the spore-bearing part 158-178 µm, with apical ring bluing in Melzer's iodine reagent, more or less urn-shaped, 7-8 µm high X 4-5 µm broad. Ascospores brown to dark brown, unicellular, ellipsoid- inequilateral to navicular, smooth, 22-30(-31) X 7.5-9 µm, with spiralling or oblique germ slit less than spore-length.

SPECIMENS EXAMINED: Chacón 363, XI.1987, Ejido Julilo, Gómez Farías municipality, Tamaulipas state, on wood in subtropical forest with abundant Quercus spp. (ITCV;JDR); San Martín 35, 14.X.1986, Gómez Farías municipality, Tamaulipas state, on wood in cloud forest (ITCV); San Martín 98, 8.XII.1986, Ejido La Unión, Othón P. Blanco municipality, Quintana Roo, on wood in evergreen rain forest (ITCV;JDR); San Martín 324, 336, 399, VIII.1987, Ejido Boca de Chajul, Ocosingo municipality, Chiapas state, on wood in evergreen forest (324, 336 in ITCV;JDR; 399 in ITCV); Tinoco 27, VII.1987, "El Cielo" ranch, Gómez Farías municipality, on wood in cloud forest (ITCV;JDR).

NOTES: Our material mostly fits the common and widespread concept of X.anisopleura (see Dennis, 1956; Pérez-Silva, 1975; Rogers et al., 1988). One collection

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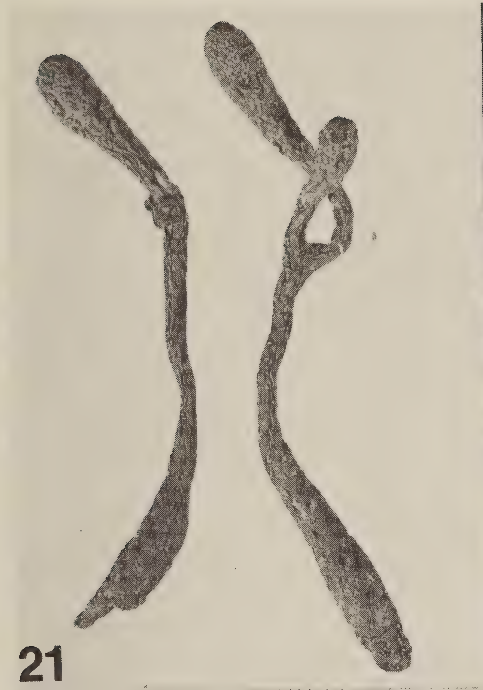
Figs. 21-28. 21,22. Xylaria claviceps. 21. Stromata, X 1. 22. Stromatal surface, X 16. 23-25. Xylaria coccophora. 23. Stromatal surface, X 16. 24. Stromata, X 2. 25. Stromata, X 2.5. 26,27. Xylaria aff. comosa. 26. Stromata, X 3. 27. Stromatal surface, X 8. 28. Xylaria cf. corniculata. Stromatal surface, X 16.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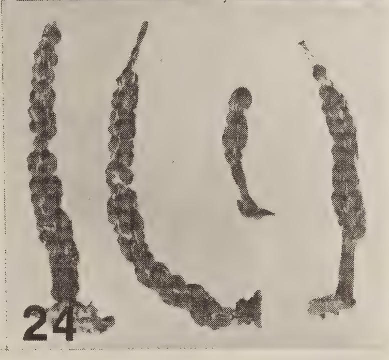
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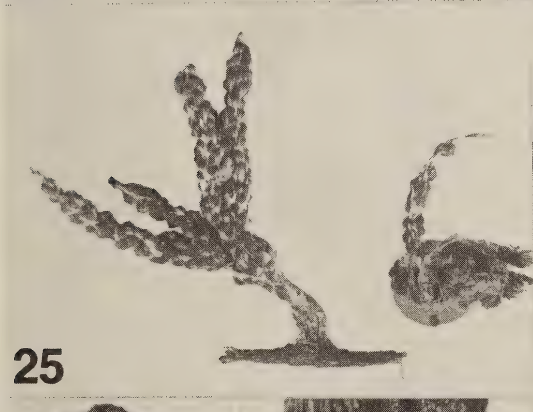
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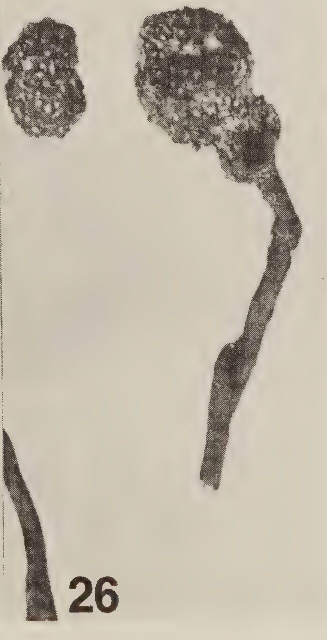
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(San Martín 399) is a curious form with small stromata and sterile acute apices. Laessøe (in litt.) has reinstated *X. globosa* that, in his opinion, is an earlier name for what is universally called *X. anisopleura*.

Xylaria arbuscula Sacc., Michelia 1:249. 1878.
Figs. 10-12.

Stromata unbranched or branched from the base or above, cylindrical to conical, with acute sterile apices, nearly sessile or on short to long, nearly glabrous to pubescent stipes, 0.3-3.5 cm total length X 1-4 mm diam; externally blackish with gray to brown peeling outer layer; internally white to yellowish. Texture fairly hard. Surface smooth to slightly wrinkled, stipes often with pubescence. *Perithecia* 0.2-0.6 mm diam. Ostioles essentially umbilicate to slightly papillate. *Asci* eight-spored, cylindrical, stipitate, 130-206 μm total length X 6.5-8 μm broad, the spore-bearing part 60-116 μm, with apical ring bluing in Melzer's iodine reagent, inverted hat-shaped, 3.5-5.5 μm high X 2.5-3 μm broad. *Ascospores* brown to dark brown, unicellular, ellipsoid-inequilateral, smooth, (12-)13-18(-19) X (4-)4.5-6 μm, with germ slit straight to undulate, 1/2 to 3/4 spore-length to only slightly less than spore-length.

SPECIMENS EXAMINED: García 5337, 9.X.1986, "El Cielo" ranch, Gómez Farías municipality Tamaulipas state, on *Quercus* sp. fruit in cloud forest (ITCV); Garza 1, VI.1981, "El Cerrito", Monterrey municipality, Nuevo León state, on wood in submontane scrub (ITCV); Moreno 3, 14.X.1986, Gómez Farías, Tamualipas state, on wood in subdeciduous rain forest (JTCV); Moreno 19, El Cercado, Santiago municipality Nuevo León state, on wood in submontane scrub (ITCV); *Pérez-Silva, E. 6053, XI.1972, near Tepoztlán, Morelos state, on *Quercus* (JDR;XAL); San Martín 4, VIII.1987, Gómez Farías, Tamaulipas state, on wood in median subdeciduous rain forest (ITCV); San Martín 14, VIII.1986, Gómez Farías, Tamaulipas state, on

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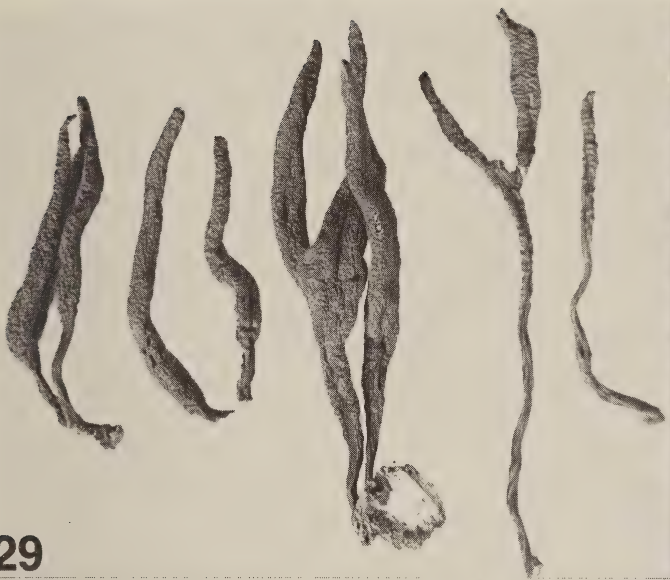
Figs. 29-34. 29. *Xylaria* cf. *corniculata*. Stromata, X 0.8. 30 *Xylaria* cf. *curta*. Stromatal surface, X 16. 31. *Xylaria* cf. *dichotoma*. Stromatal surface, X 16. 32. *Xylaria* cf. *curta*. Stromata, X 2. 33. *Xylaria* cf. *dichotoma*. Stromata, X 1.25. 34. *Xylaria* aff. *enterogena*. Stromatal surface, X 16.



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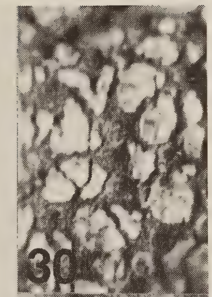

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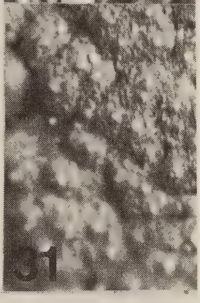

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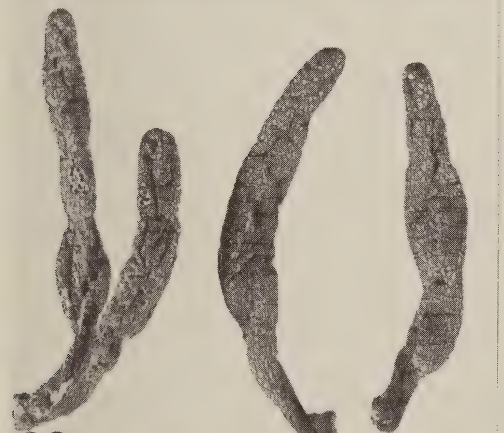

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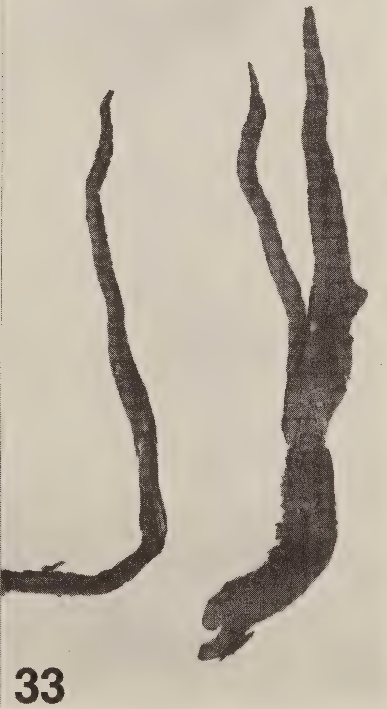

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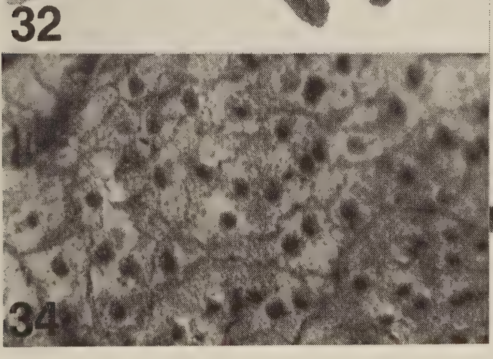

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wood in cloud forest (ITCV;JDR); San Martín 314, Ejido La Unión, Othón P. Blanco municipality, Quintana Roo state, on Swietenia macrophylla King fruit (ITCV); Silva 9, 17.VII.1987 (same date as García 5337, above)(ITCV).

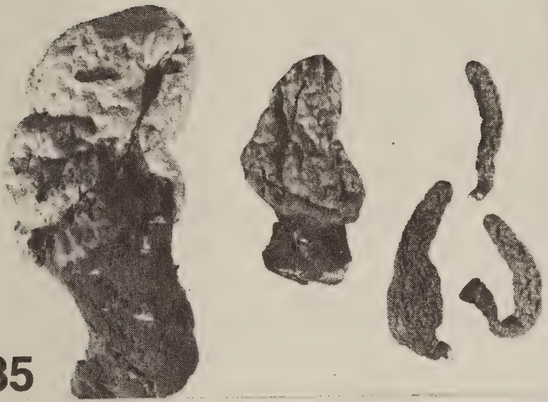
NOTES: Xylaria arbuscula is a species complex and our specimens undoubtedly encompass more than one taxon. Culturing would undoubtedly be of great utility in elucidating this assemblage, but our material was not in culturable condition. Our concept of the species is generally that of Miller (1942), Rogers & Samuels (1986), and Rogers et al. (1988). Several of the specimens cited here differ from typical material, as follow: San Martín 221 differs in conspicuous perithecial contours; San Martín 50 differs in the robust stromata; García 5250 differs in the white outer peeling layer.

Xylaria arbuscula usually occurs on wood. Two collections are from woody fruits and, thus, little pathological or ecological significance is attached to these occurrences, i.e., the fruits are viewed as akin to wood.

Xylaria sp., aff. arbuscula (Moreno 202) Figs. 13,14.

Stromata unbranched or branched, cylindrical to spathulate with acute sterile apices, on long pubescent stipes, 2.5-3 cm total length X 1-6 mm diam; externally blackish with white outer peeling layer; internally white with brownish medulla. Surface slightly rugose and otherwise roughened by ostiolar papillae. Perithecia 0.2-0.5 mm diam. Ostioles conical to hemispherical, conspicuous or obscure. Asci eight-spored, the spores arranged in a uniseriate or biseriate manner, cylindrical, stipitate, 110-131 μm total length X 7.5-8.5 μm broad, the spore-bearing part 62-77 μm, with apical ring bluing in Melzer's iodine reagent, quadrate to rectangular, 2-3 μm high X 2-3 μm broad. Ascospores dark brown, unicellular, ellipsoid-inequilateral with broadly to narrowly rounded ends, smooth, (10-)11-13(-14) X 4-5(-6) μm, with germ slit undulate to spiralling, more or less spore-length.

Figs. 35-40. 35. Xylaria aff. enterogena. Stromata, X 0.8. 36. Xylaria feejeensis. Stromata, X 1. 37,38. Xylaria gracillima. 37. Stromata, X 1.5. 38. Stromatal surface, X 16. 39. Xylaria feejeensis. Stromatal surface, X 16. 40. Xylaria grammica. Stromatal surface, X 16.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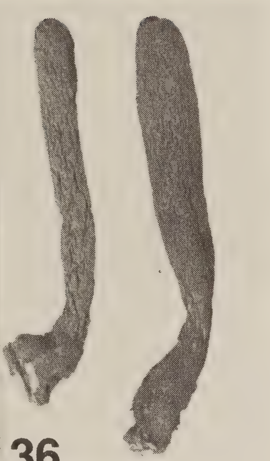
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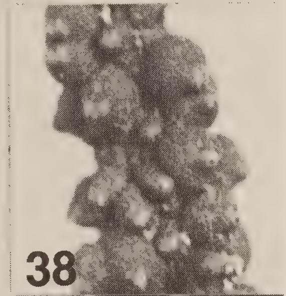
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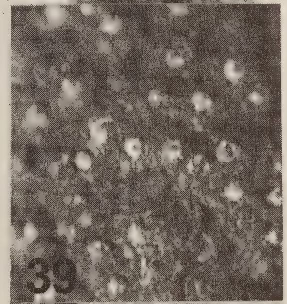
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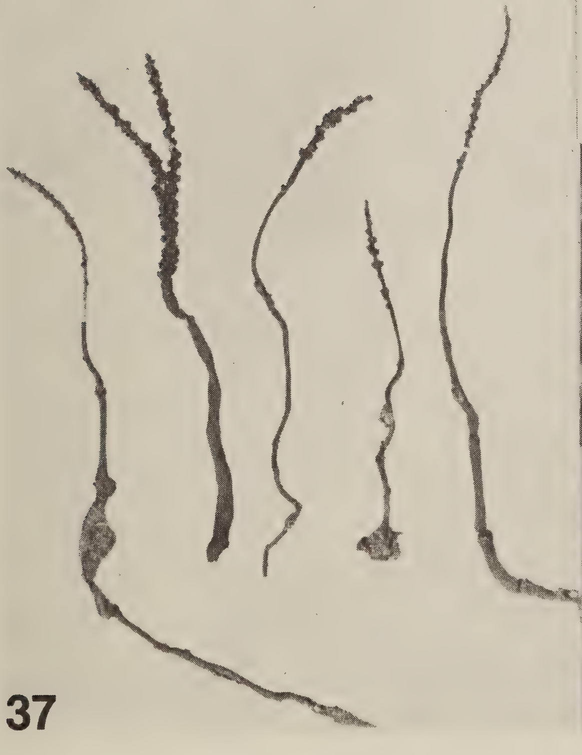
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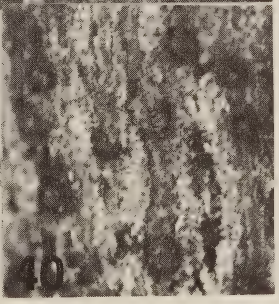
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SPECIMEN EXAMINED: Moreno, A. 202, X.1987, El Cercado, Santiago municipality, Nuevo León state, on wood in scrub forest with *Quercus* spp. (ITCV).

NOTES: This fungus looks much like a small-spored variant of *X. arbuscula*. The undulate to spiralling germ slits, however, are unlike that species. A similar fungus from Venezuela (Rogers et al., 1988) described as perhaps an atypical *X. arbuscula* probably represents the same taxon. In any case, the *X. arbuscula* complex is, as yet, poorly understood and it seems premature to formally erect another taxon until culturing has been accomplished (see notes on *X. arbuscula*).

Xylaria aristata Mont., Ann. Sci. Nat. Bot. (sér. 4) 3:106. 1855.

Stromata globose to somewhat conical with acute apices, up to 3 mm high X 2 mm diam, on long, thin finely pubescent stipes up to 1.3 cm high; externally white, becoming gray, stipes dark brown; internally white. Texture becoming fairly hard. Surface roughened with perithecial contours and ostiolar papillae. *Perithecia* 0.3-0.5 mm diam. Ostioles papillate. *Asci* eight-spored, cylindrical, 100-115 µm total length X 6-7.5 µm broad, the spore-bearing part 33-45 µm, with apical ring bluing in Melzer's iodine reagent, quadrate, 2 X 2 µm. *Ascospores* brown, unicellular, ellipsoid-inequilateral with broadly or narrowly rounded ends, smooth, 9-10(-11) X (3.5-)4-4.5 µm, with straight germ slit ca. 3/4 spore-length.

SPECIMEN EXAMINED: San Martín 213, 2.VIII.1987, Ocampo, Tamaulipas state, on fallen fruits of *Guazuma ulmifolia* Lam., aquiche in median subdeciduous rain forest (ITCV).

NOTES: Our material is much as illustrated by Dennis (1956) except that perithecial contours of our material are more evident and the color is lighter. This species usually occurs on leaves; ours is the first report known

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Figs. 41-47. 41. *Xylaria grammica*. Stromata, X 1. 42,43. *Xylaria guyanensis*. 42. Stromata, X 1. 43. Stromatal surface, X 16. 44. *Xylaria kegeliana*. Stroma, X 1.5. 45,46. *Xylaria juruensis*. 45. Stromata, X 2.8. 46. Stromatal surface, X 16. 47. *Xylaria kegeliana*. Stromatal surface, X 16.

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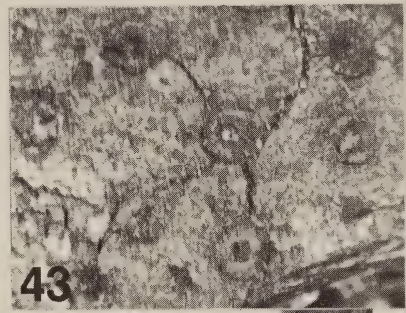
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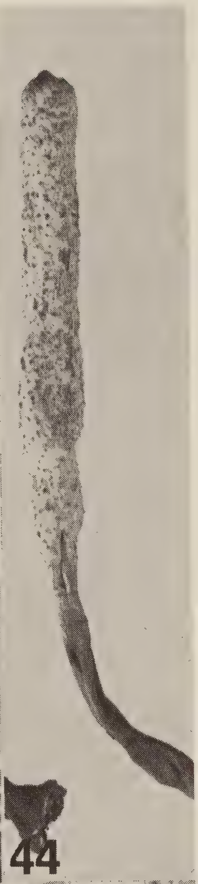
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to us of its occurrence on fruits. See also description and notes on *Xylaria* sp. (SM 337) herein.

Xylaria sp., aff. *bambooensis* Lloyd, Mycol. Notes 72, Mycol. Writ. *7*:1285. 1924. Figs. 17,18,143.

Stromata unbranched or branched, upright or prostrate, *cylindrical* with crowded conspicuous to more or less naked perithecia, with long acute sterile apices, on short stipes arising from swollen bases, 1.5-4 cm total length X 1-2 mm diam; externally blackish with evidence of brown outer peeling layer; internally white. Texture soft. Surface roughened from perithecia and tomentum, the stipes and lower fertile parts particularly tomentose. *Perithecia* 0.2-0.3 mm diam. Ostioles finely papillate, the papillae sometimes surrounded by a depressed annulus. *Asci* eight-spored, arranged in uniseriate or biseriate manner, short-stipitate, 76-94 µm total length X 5.5-7.5 µm broad, the spore-bearing part 56-63 µm, with apical ring bluing in Melzer's iodine reagent, quadrate, 2 X 2 µm. *Ascospores* light brown, unicellular, ellipsoid-inequilateral to allantoid, smooth, (10.5-)11-12 X 3-4 µm, with germ slit obscure.

SPECIMEN EXAMINED: Guevara 731, 1986, between Plan de la Noria and San Isidro, José María Morelos municipality, Quintana Roo state, on monocot wood in an acahual (ITCV; JDR).

NOTES: This fungus greatly resembles Lloyd's photograph of *X. bambooensis* (Lloyd, 1924B). The ascospores of our material are much smaller than reported by Lloyd, i.e., 20 X 6 µm. They are morphologically much like the ascospores described for *X. magnoliae* herein and another taxon described elsewhere as *Xylaria* sp. aff. *magnoliae* (Rogers et al., 1988). The *stromata* likewise *resemble X. magnoliae* and *X. ianthino-velutina*, but the known host ranges of these fungi do not include monocots. Thus, it

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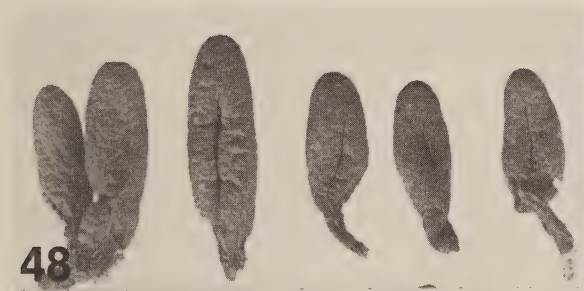
Figs. 48-54. 48. *Xylaria* cf. *laevis*. Stromata, X 1.3. 49-50. *Xylaria longipes*. 49. Stromatal surface, X 16. 50. Stromata, X 1.5. 51. *Xylaria longipes* var. *tropica*. Stromata, X 1.25. 52. *Xylaria* sp. aff. *feejeensis*. Stroma, X 3.25. 53,54. *Xylaria guazumae*. 53. Stromata on fruit, X 1.66. 54. Fertile part, X 16.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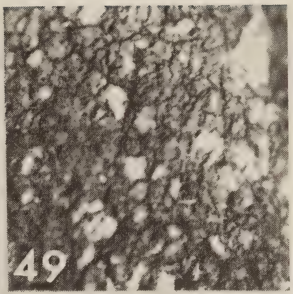
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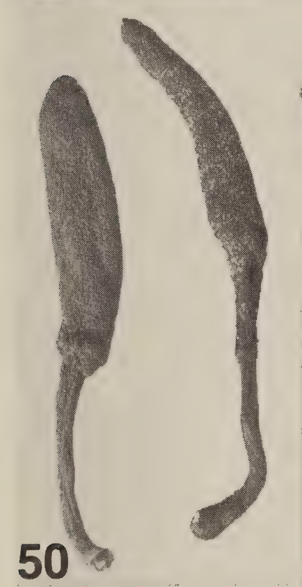
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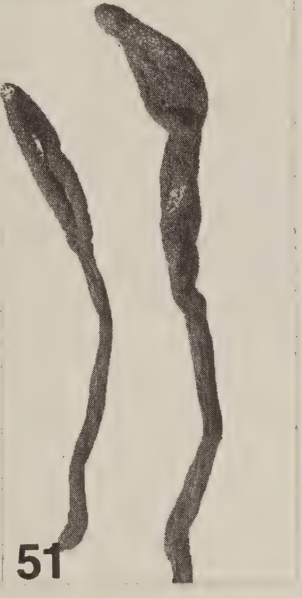
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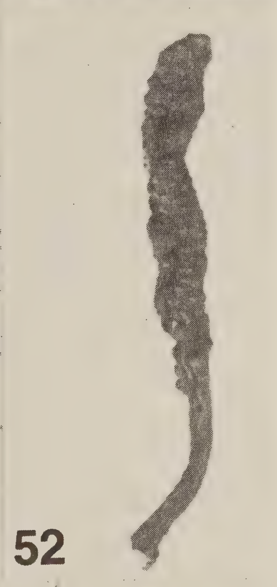
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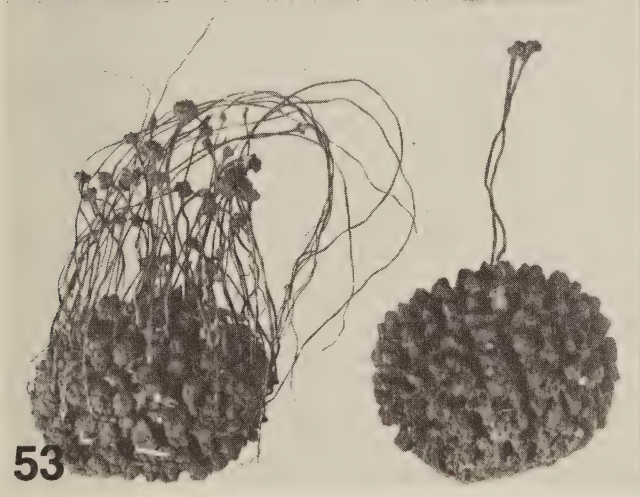
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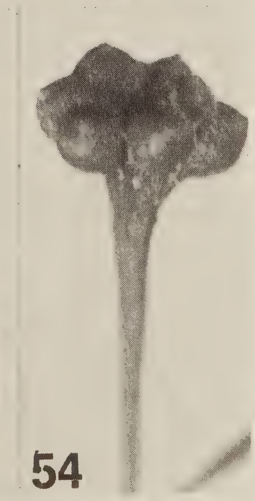
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is inappropriate at this time to assign this fungus to a known species or to erect a new one.

Xylaria brachiata Sacc., Ann. Mycol. 4:75. 1906.

Stromata unbranched or branched, upright or prostrate, the fertile part short cylindrical to fusoid with perithecia immersed or with evident perithecial contours, with acute sterile apices, 1.5-1.8 cm long X 1-2 mm diam, on long thin tomentose stipes 6 cm or longer; externally black with dark brown outer peeling layer; internally white. Texture fairly hard. Surface smooth to roughened with perithecial contours, ostiolar papillae, and peeling outer layer. *Perithecia* 0.3-0.5 mm diam. Ostioles inconspicuous to papillate. *Asci* eight-spored, cylindrical, 130-160 µm total length X 7-8 µm broad, the spore-bearing part 85-92 µm, with apical ring bluing in Melzer's iodine reagent, rectangular, 3.5-4 µm high X 1.5-2.5 µm high. *Ascospores* brown, unicellular, ellipsoid-inequilateral with broadly rounded ends, smooth, 11-14(-16) X 5-6 µm, with straight germ slit spore-length.

SPECIMEN EXAMINED: Chacón 102, X.1987, Ejido Alta Cima, Gómez Farías municipality, Tamaulipas state, on wood in cloud forest (ITCV).

NOTES: Dennis (1958) placed *X. brachiata* into synonymy with *X. mellisii* (Berk.) Cooke [as *Xylosphaera mellisii* (Berk.) Dennis]. Theissen (1909) likewise considered it close to *X. arbuscula* Sacc. (which Dennis also placed into synonymy with *X. mellisii*). Lloyd (1919) accepted *X. brachiata* and his photograph (Fig. 1561) looks very much like our material. Later, Lloyd (1924A) wrote that *X. brachiata* appeared to be too close to *X. apiculata* to be maintained as a separate species. Rogers et al. (1988) tentatively identified a collection growing on leaves from Venezuela as *X. brachiata*. The present

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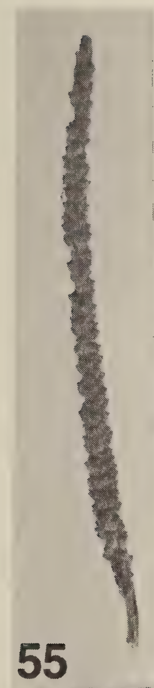
Figs. 55-61. 55,56. *Xylaria magniannulata*. 55. Stroma, X 2. 56. Stromatal surface, X 12. 57,58. *Xylaria magnoliae*. 57. Stromatal surface, X 16. 58. Stromata on *Magnolia* fruit, X 1. 59,60. *Xylaria maitlandii*. 59. Stromata, X 2.3. 60. Surface of fertile part and upper stipe (left) and lower stipe (right), X 16. 61. *Xylaria* cf. *mellisii* var. *nuda*. Stromata, X 1.66.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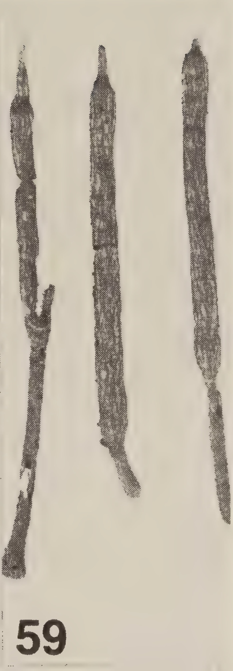
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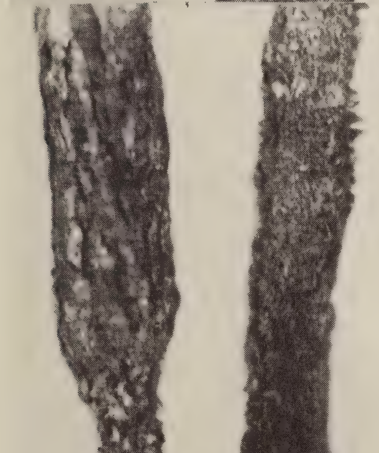
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material, like Saccardo's type, is from wood. Cultural and other studies might clarify the status of X. brachiata.

Xylaria cf. brevipes Sacc., Jour. Mycol. 12:47. 1906.
Figs. 19,20.

Stromata cylindrical to clavate with acute sterile apices, on short tomentose stipes arising from bulbous bases, ca. 2 cm total length X 2-3 mm diam; externally blackish; internally whitish. Texture woody. Surface rugose and roughened by cracking and verrucae. Perithecia 0.3-0.5 mm diam. Ostioles finely papillate. Asci eight-spored, long-stipitate, 130-155 μm total length X 4-5 μm broad, the spore-bearing part 75-85 μm, with apical ring bluing in Melzer's iodine reagent, quadrate, 2 X 2 μm. Ascospores brown, unicellular, ellipsoid-inequilateral with broadly or narrowly rounded ends, smooth, 10-11 X 3.5-4 μm, with straight germ slit spore-length.

SPECIMEN EXAMINED: Acosta 8, 8.VI.1984, Raíces, Monterrey municipality, Nuevo León state, on wood in submontane scrub (ITCV;JDR).

NOTES: This is another small Xylaria that seems close to X. feejeensis. It resembles Lloyd's description and photograph (1924A) of X. brevipes. We have not seen type material of X. brevipes.

Xylaria claviceps San Martín & Rogers, sp. nov.
Figs. 21,22,131-133.

Stromata non ramosa vel ramosa, regulatim clavata apicibus rotundatis fertilibus, in stipitibus longitudine 3/4 stromatis aequantibus gestis, e basibus conspicuis tumidis pannosis exorientibus, 7-8 cm longa X 5-7 mm

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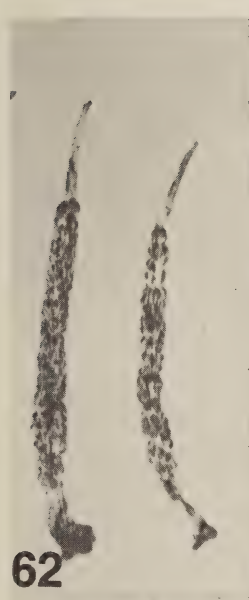
Figs. 62-71. 62,63. Xylaria cf. microceras. 62. Stromata, X 2.3. 63. Stromatal surface, X 16. 64,65. Xylaria multiplex. 64. Stromatal surface, X 16. 65. Stromata X 3. 66,67. Xylaria "muscula". 66. Stroma X 2.8. 67. Stromatal surface, X 16. 68,69. Xylaria cf. nigrescens. 68. Stromata, X 1.3. 69. Stromatal surface, X 16. 70,71. Xylaria oxyacanthae. 70. Stromata, X 1.3. 71. Stromatal surface, X 16.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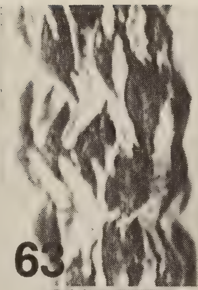
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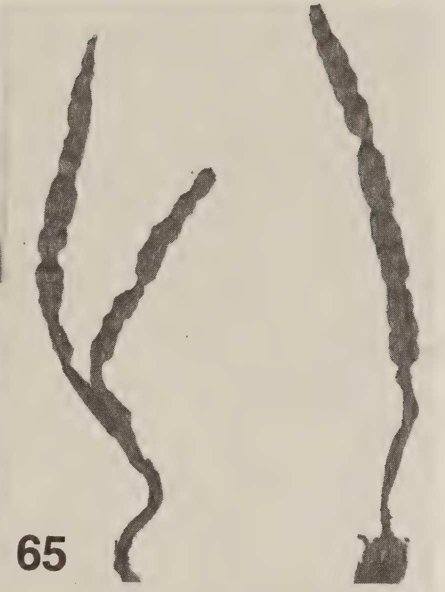
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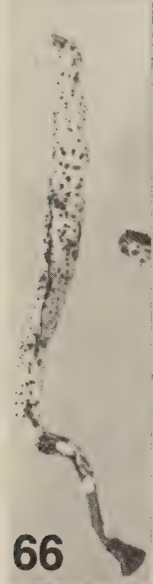
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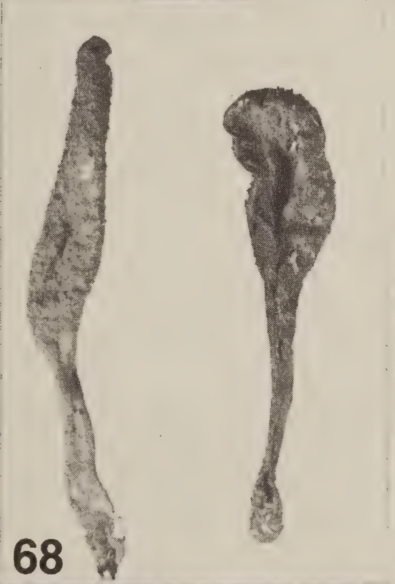
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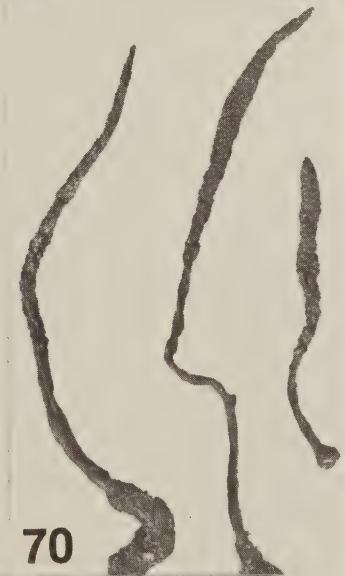
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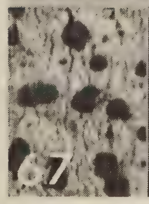
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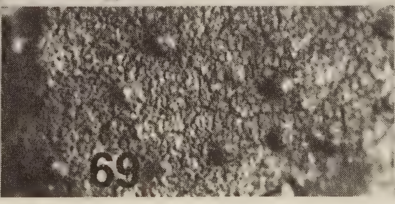
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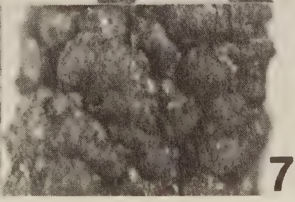
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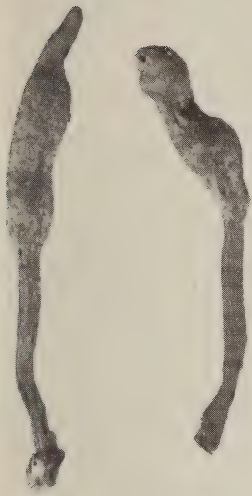
crassa; extus atra cum strato exteriore cinereo delapso, ostiolis ab albida materia circumcintis; intus alba. Textura similis casio vel lignosa. Superficies asperata ab parvis rugis, strato delapso, et papillis ostiolorum. Perithecia 0.3-0.5 mm diam. Ostiola papillata. Asci ostospori, cylindrici, longe stipitati, 92-122 µm longitudine tota X 5.5-6 µm crassi, partibus sporiferis 46-62 µm, annulo apicali in liquore Melzeri cyanescente, quadrato, 2 X 2 µm. Ascosporae fuliginosae, unicellulares, late ellipsoideo-inequilaterales, leves, (8-)8.5-9 (-10) X 4-5 µm, rima germinativa inconspicua recta plus minusve longitudine sporae. Status anamorphosus ignotis.

Stromata unbranched or branched, regularly clavate with rounded fertile apices, on long stipes representing ca. 3/4 of entire length, originating from conspicuous swollen pannose bases, 7-8 cm long X 5-7 mm diam; externally dull black with gray outer shredding or flaking layer, the ostiolar areas surrounded by whitish material; internally white. Texture cheesy to woody. Surface roughened by small wrinkles, peeling layer, and ostiolar papillae. Perithecia 0.3-0.5 mm diam. Ostioles papillate. Asci eight-spored, cylindrical, long-stipitate, 96-122 µm total length X 5.5-6 µm broad, the spore-bearing part 46-62 µm, with apical ring bluing in Melzer's iodine reagent, quadrate, 2 X 2 µm. Ascospores nearly black, unicellular, broadly ellipsoid-inequilateral, smooth, (8-)8.5-9(-10) X 4-5 µm, with inconspicuous straight germ slit more or less spore-length.

SPECIMEN EXAMINED: San Martín 356, VIII.1987, "El Muneco", Ejido Loma Bonita, Ocosingo municipality, Chiapas state, on wood in evergreen rain forest (HOLOTYPE:ITCV).

NOTES: This fungus has a great resemblance to X. hyperythra (Mont.) Fr. as illustrated by Dennis (1956). The surface of our fungus is grayish rather than cinnamon-colored and the ascospores are much smaller than those reported for X. hyperythra.

Figs. 72-78. 72. Xylaria pallida. Stromata, X 2. 73, 74. Xylaria pallide-ostiolata. 73. Stroma, X 0.6. 74. Ostioles, X 16. 75,76. Xylaria persicaria. 75. Stromatal surface, X 16. 76. Stromata on fruit, X 2. 77,78. Xylaria phyllocharis. 77. Stromata, X 3. 78. Fertile part, X 26.



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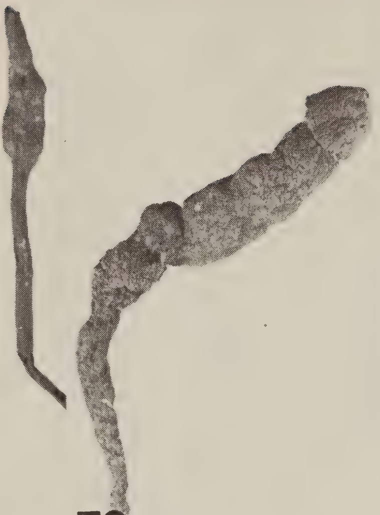

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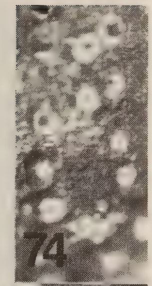

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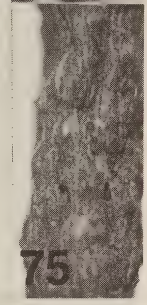

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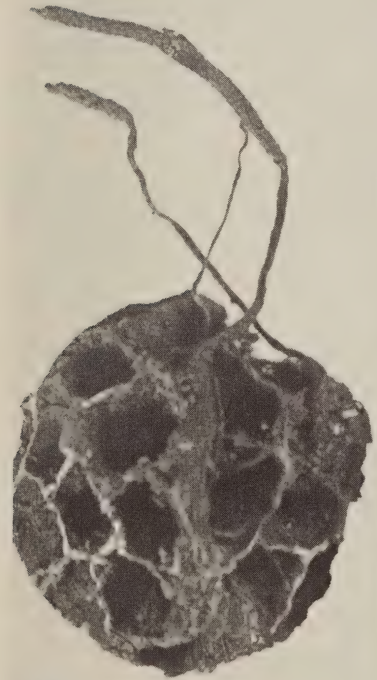

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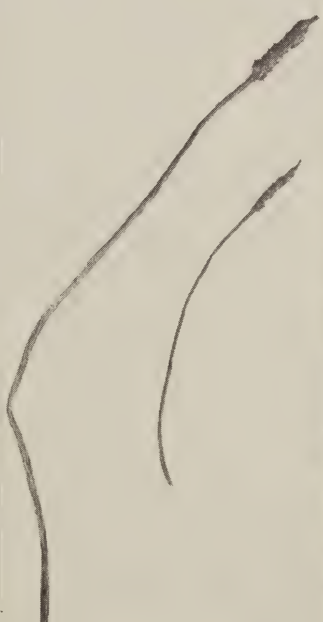

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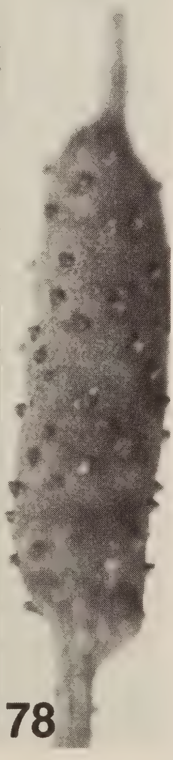

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Xylaria coccophora Mont., Ann. Sci. Nat. Bot. (sér. 3) 3:109. 1855. Figs. 23-25.

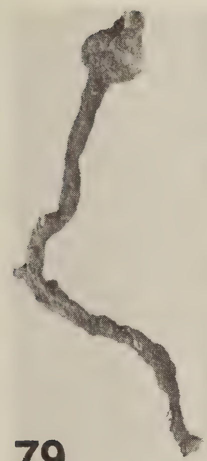
Stromata unbranched or with 2 or more branches, cylindrical bearing more or less conspicuous perithecia, with acute sterile apices, on short to long smooth stipes, 1.5-6 cm total length X 1-3 mm diam; externally black with remains of whitish, yellowish or brownish peeling outer layer; internally white. Texture fairly soft. Surface nodulose from perithecial contours. Perithecia 0.4-0.8 mm diam. Ostioles slightly raised. Asci eight-spored, cylindrical, stipitate, 150-163 µm total length X 5-5.5 µm broad, the spore-bearing part 80-88 µm, with apical ring bluing in Melzer's iodine reagent, quadrate, 2.5-3 X 2.5-3 µm. Ascospores brown, unicellular, ellipsoid-inequilateral with rounded ends, smooth, 10-11(-13) X (3.5-)4-4.5 µm, with straight germ slit less than spore-length.

SPEICMENS EXAMINED: Chacón-Jiménez 192, 1.XI.1987, Ejido Alta Cima, Gómez Farías municipality, Tamaulipas state, on wood in cloud forest (ITCV;JDR); García 5423, 10.XII.1986, Felipe Carrillo Puerto, Quintana Roo state, on wood in median subdeciduous rain forest (ITCV;JDR); San Martín 101, 8.XII.1986, Ejido La Unión, Othón P. Blanco municipality, Quintana Roo state, on wood in subdeciduous rain forest (ITCV;JDR).

NOTES: This material fits our concept of X. coccophora (see Dennis, 1956; Rogers et al., 1988). Laessøe (in litt.) indicates that some material from México would be better placed in X. compressa Pat. et Gaill. (see also Joly, 1968 and Pérez-Silva, 1975).

Xylaria aff. comosa (Mont.) Fr., Summa Veg. Scand. Sect. Post., p. 381. 1849. Figs. 26,27.

Figs. 79-87. 79. Xylaria polymorpha. "Ophiopoda" type stroma, X 0.5. 80,81. Xylaria scabriclavula. 80. Stromata, X 5.75. 81. Stromatal surface, X 16. 82,83. Xylaria schweinitzii. 82. Stroma, X 2. 83. Stromatal surface, X 16. 84. Xylaria scruposa. Stromata, X 1. 85,86. Xylaria sp. G 729. 85. Stromata, X 1.3. 86. Stromatal surface, X 16. 87. Xylaria scruposa. Stromatal surface, X 16.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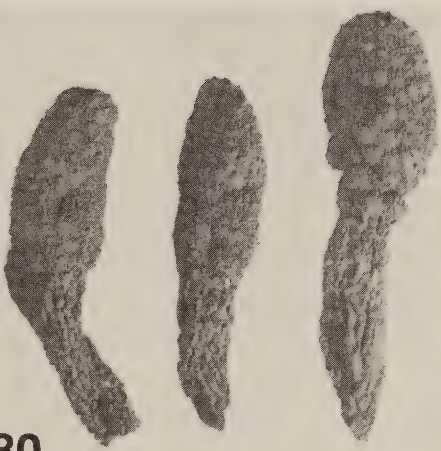
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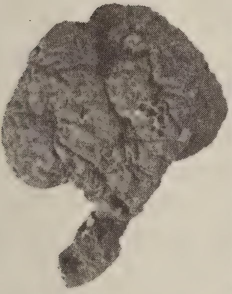
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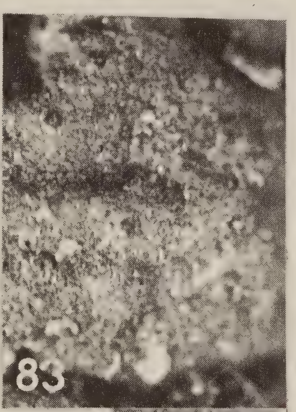
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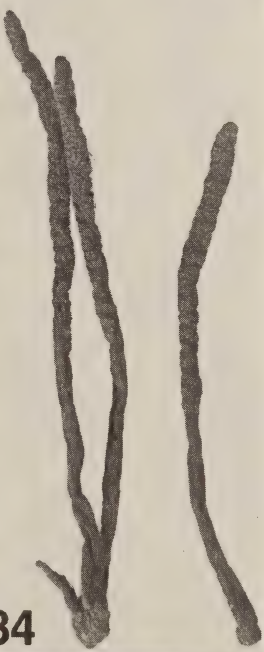
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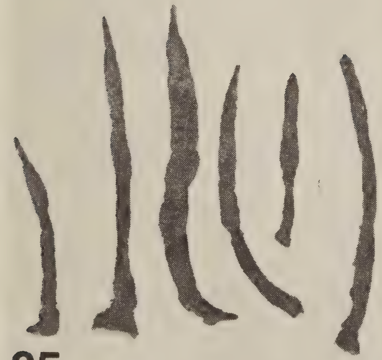
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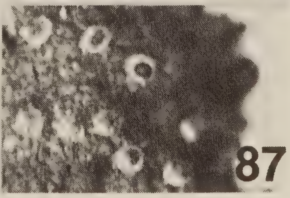
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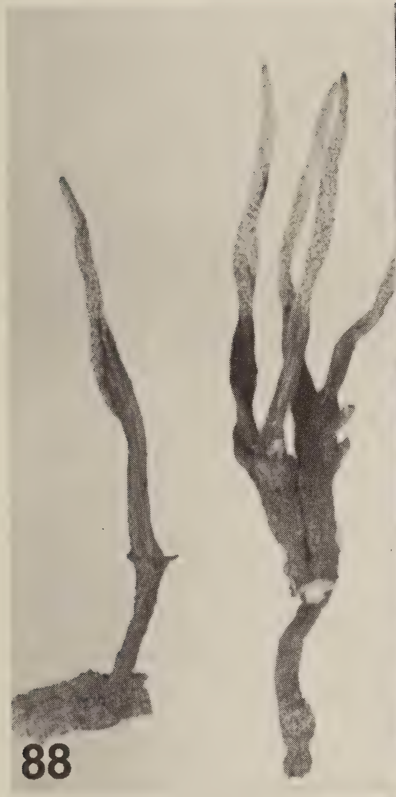
Stromata subglobose to pyriform to oblong, up to 1 cm long X 5 mm diam, on long thin stipes up to 4 cm long X 1-1.5 mm diam; externally shiny black with white sloughing patches; internally white and perhaps becoming hollow. Texture very hard. Surface smooth except for white sloughing patches, ostiolar papillae, remnants of conidial processes immediately below fertile part, and short hairs on stipe. *Perithecia* not seen intact. Ostioles strongly papillate. *Asci* not seen. *Ascospores* brown, unicellular, ellipsoid-inequilateral with abrupt pinched ends, smooth, (25-)29-33(-36) X 7-8(-9) µm, with germ slit straight, slightly less than full-length.

SPECIMEN EXAMINED: San Martín 350, "El Muneco, Ejido Loma Bonita, VIII. 1987, Ocosingo municipality, Chiapas state, on wood in evergreen rain forest (ITCV).

NOTES: Our stomata are smaller than those reported by Dennis (1956) and Rogers et al. (1988). Material of the latter authors have ascospores with spiral germ slits, whereas our ascospores have straight germ slits. T. Laessøe (in litt.) reports that the type of *X. comosa* is sterile. The lectotype selected by him has ascospores with straight germ slits, long secondary appendages, and according to our data, a cellular appendage on one end. Material having ascospores with a spiralling germ slit and devoid of appendages [such as described by Rogers et al. (1988)] is being described as *X. comosoides* Laessøe. Our present material differs from *X. comosa sensu* Laessøe in the generally smaller fertile parts and in having ascospores without appendages. We thus hesitate to call our material *X. comosa* until additional collections have been made and relevant cultures compared.

Figs. 88-98. 88,89. *Xylaria* cf. *longiana*. 88. Stromata, X 1.8. 89. Stromatal surface, X 16. 90. *Xylaria* sp. SM 39. Stromatal surface, X 16. 91. *Xylaria* sp. SM 64. Stromatal surface, X 16. 92. *Xylaria* sp. SM 39. Stromata, X 2. 93. *Xylaria* sp. SM 64. Stromata, X 2. 94. *Xylaria* sp. SM 211. Stroma on leaf, X 4.5. 95,96. *Xylaria* sp. SM 303. 95. Stromata, X 1.75. 96. Stromatal surface, X 16. 97,98. *Xylaria* sp. SM 359. 97. Stromata, X 7. 98. Stromatal surface, X 16.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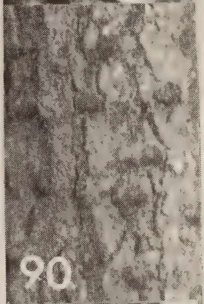
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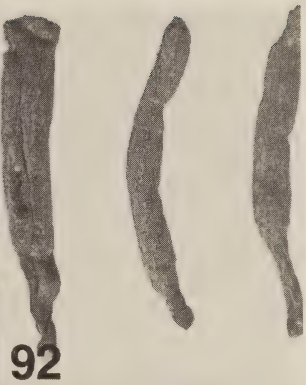
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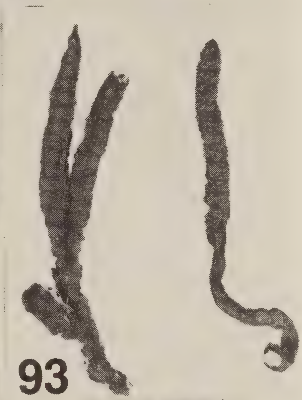
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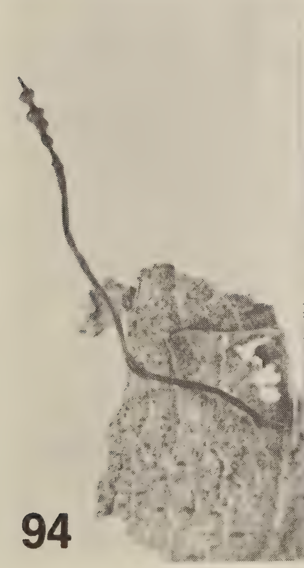
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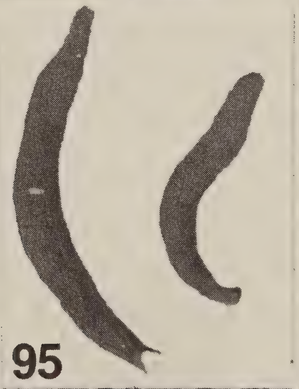
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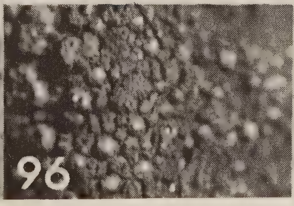
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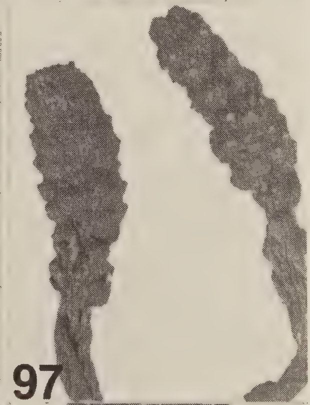
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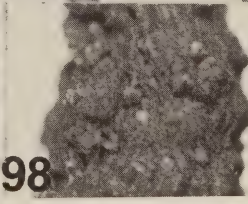
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Xylaria cf. *corniculata* Sacc., Ann. Mycol. 4:75. 1906
Figs. 28,29.

Stromata unbranched or branched, clavate to irregular, terete to compressed, with sterile acute apices, on short to long stipes, 4-9 cm total length X 2-5 mm diam; externally blackish with brown peeling outer layer; internally white. Texture woody. Surface roughened by wrinkles and ostiolar papillae; stipes sometimes tomentose. *Perithecia* 0.4-0.6 mm diam. Ostioles papillate. *Asci* eight-spored, cylindrical, stipitate, 144-186 µm total length X 7.5-9 µm broad, the spore-bearing part 104-126 µm, with apical ring bluing in Melzer's iodine reagent, rectangular, 5-6 µm high X 4-5 µm broad. *Ascospores* brown to dark brown, unicellular or with minute hyaline cellular appendage, ellipsoid-inequilateral to navicular, with narrowed to acute ends, smooth, (15.5-)16.5-18(-20) X 6-7(-7.5) µm, with spiralling germ slit spore-length.

SPECIMENS EXAMINED: Chacón 110, XI.1987, Ejido La Libertad, Llera municipality, Tamaulipas state, on wood in riparian site (ITCV:JDR); García 4913B, X.1985 and 4949, 4.X.1985, "El Cielo" ranch, Gómez Farías municipality, Tamaulipas state, on wood in cloud forest (ITCV:JDR); San Martín 209, 16.VII.1987, data as García (above)(ITCV:JDR).

NOTES: These collections resemble *X. scruposa* in ascospore size and gross morphology of stromata. Ascospore germ slits are spore-length in this material; they usually are less than spore-length in undoubted *X. scruposa*. Our material fits the Saccardo description of *X. corniculata* Sacc. and, although we have not seen type material, we tentatively consider it to be this species. Our material is reminiscent of Lloyd's photograph (Fig. 2675)(1924A) of *X. corniculata*.

Xylaria cubensis (Mont.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 126. 1851.

Stromata clavate with rounded fertile apices, on short stipes, 1.7-5 cm total length X 7-10 mm diam; externally copper-colored, blackening with age; internally white, becoming hollow and inrolled. Texture hard, but fragile. Surface smooth except for osiolar papillae and fine cracking. *Perithecia* 0.4-0.6 mm diam.

Ostioles finely papillate. *Asci* eight-spored, cylindrical, long-stipitate, 125-160 µm total length X 4-6 µm broad, the spore-bearing part 58-65 µm long, with apical ring bluing in Melzer's iodine reagent, quadrate, 2 X 2 µm. *Ascospores* brown to almost black, unicellular, ellipsoid-inequilateral with rounded ends, smooth, (7-) 8-10(-11) X 4-5(-6) µm, with germ slit unclear, but probably long.

SPECIMENS EXAMINED: Guevara 723, no date, "San Miguel" ranch, José María Morelos municipality, Quintana Roo state, in acahual (ITCV,JDR); *Madrigal Xavier 2138-12, near Chocolhaito, Chakalah, Chiapas state (JDR,XAL); San Martín 1, 17.VIII.1986; 15, 1985; 24, 14.X.1986, Gómez Farías, Tamaulipas state, on wood in subdeciduous rain forest (ITCV,JDR); San Martín 387, VI.1987, Ocampo, Tamaulipas state, on wood in subdeciduous rain forest.

NOTES: Most of the material fits our concept of *X. cubensis* (and see Rogers, 1984B; Rogers et al., 1988). Pérez-Silva (1975) has described and illustrated it from México. One collection (San Martín 15) is atypical in having conspicuous surface scales, solid flesh at maturity, and somewhat longer ascospores (9-12 X 4-5 µm).

Xylaria cf. *curta* Fr., Nova Acta Regiae Soc. Sci. Upsal. *(ser. 3) 1*, p. 126. 1851. Figs. 30,32.

Stromata unbranched or branched, cylindric-clavate with rounded fertile apices, on stipes often arising from pannose bases, 1.5-3.5 cm total length X 2.5-5 mm diam; externally blackish with whitish to tan sloughing scales; internally white. Texture woody. Surface roughened by wrinkles and scales. *Perithecia* 0.3-0.5 mm diam. Ostioles inconspicuously papillate. *Asci* eight-spored, cylindrical, long-stipitate, 117-158 µm total length X 5-6.5 µm broad, the spore-bearing part 65-73 µm, with apical ring bluing in Melzer's iodine reagent, quadrate, 1.5-2 X 1.5-2 µm. *Ascospores* brown, unicellular, ellipsoid-inequilateral with broad to narrow ends, smooth, (9.5-)10-11 X 4-4.5 µm, with straight germ slit more or less spore-length.

SPECIMEN EXAMINED: García 5404, 2.VII.1986, Gómez Farías, Tamaulipas state, on wood in median subdeciduous rain forest (ITCV).

NOTES: This fungus is placed in X. curta primarily on ascospore size and the white scales on stromata. Stromata are less robust than usually encountered (Dennis, 1956; Rogers, 1983).

Xylaria cf. dichotoma (Mont.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 127. 1851.
Figs. 31,33.

Stromata unbranched or branched, cylindrical, terete or compressed, bearing perithecia with more or less evident contours, with acute sterile apices, on ill-defined stipes, up to 7 cm total length X 2-4 mm diam; externally dark brownish to blackish; internally white. Texture soft to somewhat woody. Surface roughened with perithecial contours, wrinkles, and tomentum, the stipes conspicuously tomentose. Perithecia 0.3-0.7 mm diam. Ostioles finely papillate. Asci eight-spored, the spores arranged in a uniseriate or partly biseriate manner, cylindrical, long-stipitate, 112-150 µm total length X 4-6.5 µm broad, the spore-bearing part 59-75 µm long, with apical ring bluing in Melzer's iodine reagent, rectangular, 2-3 µm high X 1.5-2 µm broad. Ascospores yellowish, unicellular, ellipsoid-inequilateral to fusoid or crescentic, smooth, 10-13(-14) X (2.5-)3-4 µm, with germ slit obscure.

SPECIMEN EXAMINED: Garza-Ocañas 608, 18.VIII.1986, Ejido La Encantada Zaragoza municipality, Nuevo Leon state, on Quercus sp. wood in Quercus - Pinus forest (ITCV).

NOTES: Our material seems to represent X. dichotoma in general stromatal morphology and ascospore size. However, the ascospores are paler and more crescentic than usually encountered and the germ slit obscure. There is the same problem in assigning this fungus without question to X. dichotoma as encountered in assigning certain collections to X. ianthino-velutina and X. magnoliae, as discussed by

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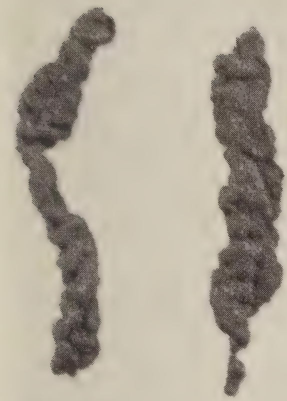
Figs. 99-107. 99,100. Xylaria sp. SM 331. 99. Stromata, X 3.8. 100. Stromatal surface, X 16. 101,102. Xylaria sp. SM 372. 101. Stromatal surface, X 16. 102. Stromata, X 2.5. 103, 104. Xylaria squamulosa. 103. Stromata, X 3.6. 104. Stromatal surface, X 16. 105-107. Xylaria uniapiculata. 105,106. Stromata, X 1.6. 107. Stromatal surface, X 16.



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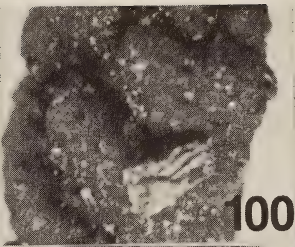

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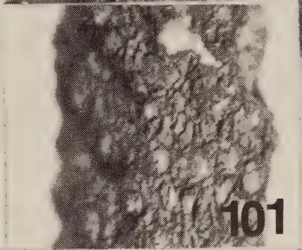

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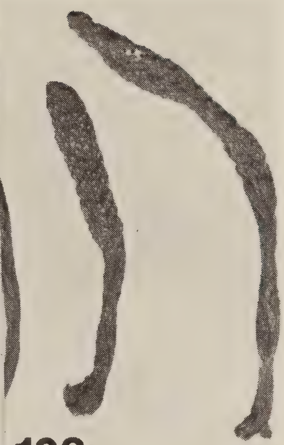

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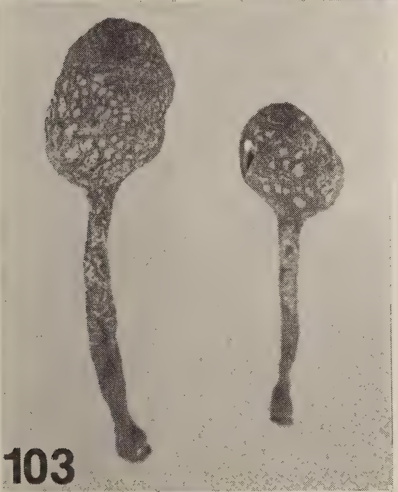

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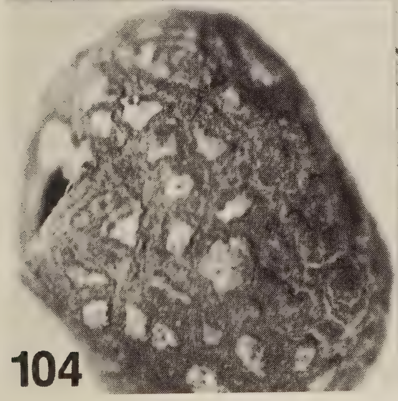

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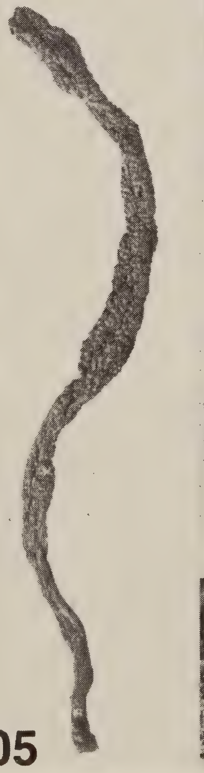

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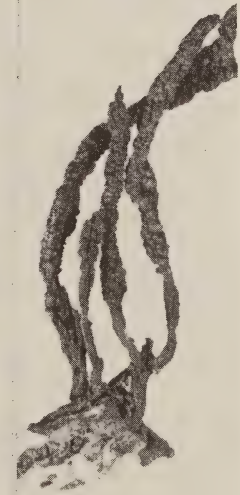

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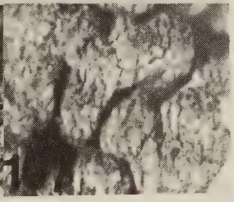

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Rogers et al. (1988). Until such species or species complexes are more widely collected and cultured and otherwise compared, their status will remain uncertain.

Xylaria aff. *enterogena* (Mont.) Fr., Nova Acta Regiae *Soc. Sci. Upsal.* (ser. 3) 1, p. 127. 1851.
Figs. 34,35,146-148.

Stromata conical to irregular with rounded fertile apices, on short to long stout stipes, 1.8-6.8 cm total length X 0.4-3 cm diam, externally dirty white to yellowish with black ostioles and fine cracks, the stipes reddish brown, pannose and spongy; internally whitish, sometimes with perithecia deep within the flesh. Texture very hard. Surface smooth except for major wrinkling and infolding. *Perithecia* 0.5-1 mm diam. Ostioles slightly raised. *Asci* eight-spored, cylindrical, stipitate, 232-276 µm total length X 8.5-12 µm broad, the spore-bearing part 156-170 µm long, with apical ring bluing in Melzer's iodine reagent, quadrate to slightly cuneate, 3.5-4 µm high X 2.5-3.5 µm broad. *Ascospores* dark brown, unicellular, ellipsoid-inequilateral with broadly or narrowly rounded ends, smooth, (19-)20-23(-25) X 8-9.5(-10) µm, with spiralling germ slit.

SPECIMENS EXAMINED: Jesús García 7, no date, "Rincon de la Sierra", Villa Juarez municipality, Nuevo León state, on wood in forest of *Quercus* spp. and *Sargentia* sp. (ITCV); Avalos 25, VII.1987, Ejido Conrado Castillo, Hidalgo municipality, Tamaulipas state, on wood in cloud forest (ITCV, JDR); Martínez 26, 8.VII.1984, "El Cielo" ranch, Gómez Farías municipality, Tamaulipas state, on wood in cloud forest (ITCV, JDR).

NOTES: Our fungus resembles *X. enterogena* in the color of the fertile part. It differs in being much more robust, in having spongy pannose stipes, and in having definitely raised ostiolar rims. It has apparently been encountered only in México and might represent a new taxon.

Xylaria enterogena is a subject of confusion. Dennis (1956) considered it to be a form of *X. telfairii*. Rogers et al. (1988) considered it different from *X. telfairii* by reason of its smaller stromata, ascospore characteristics, stromatal color, and cultural characteristics. There is no question, however, that *X. enterogena* and *X. telfairii* are closely related.

Martin (1970) indicated that *X. enterogena* is clavate, hollow, and has ascospores with spiralling germ slits. This latter feature agrees with our present material. However, the size of ascospores of our material averages larger than ascospores cited by Martin (1970) and Rogers et al. (1988).

Saccardo (1882), citing Montagne, mentioned solid stromata and deeply embedded perithecia in addition to more common shallowly placed ones. Some of our material shows deeply embedded perithecia.

Xylaria feejeensis (Berk.) Fr., *Nova Acta Regiae Soc. Sci. Upsal.* (ser. 3) 1, p. 128. 1851.
Figs. 36,39.

Stromata unbranched or branched, cylindric-clavate, spathulate, or irregular, with rounded fertile apices, on short to long stipes that sometimes originate from pannose bases, 2.5-6.5 cm total length X 5-10 mm diam; externally dull blackish, the ostiolar area sometimes surrounded by white deposits; internally white to yellowish. Surface roughened by wrinkles and ostiolar papillae and, frequently, by surface cracking and/or perithecial contours. *Perithecia* 0.4-0.8 mm diam. Ostioles finely papillate to discoid. *Asci* eight-spored, cylindrical, long-stipitate, 102-135 µm total length X 4.5-5.5 µm broad, the spore-bearing part 62-70 µm, with apical ring bluing in Melzer's iodine reagent, quadrate, 2 µm high X 1.5-2 µm broad. *Ascospores* brown to nearly black, unicellular, ellipsoid-inequilateral with rounded ends, smooth, (8-)8.5-11(-12) X 4-4.5(-5) µm, with straight germ slit spore-length or nearly so, sometimes inconspicuous.

SPECIMENS EXAMINED: *Alonso, L. 38, San Rafael municipality, México state, on wood (JDR;XAL); García 3181, 9.X.1983 and San Martín 391, IX.1987, El Cercado, Santiago municipality, Nuevo León state, on wood in submontane scrub (ITCV;JDR); García 5106, 2.VII.1986 and San Martín 723, 21.VII.1986, Gómez Farías, Tamaulipas state, on wood in median subdeciduous rain forest (5106 in ITCV;JDR; 723 in ITCV); San Martín 241, 10.VIII.1987, Ocampo, Tamaulipas state, on wood in median subdeciduous rain forest (ITCV;JDR); San Martín 328, Ejido Boca de Chajul, Ocosingo municipality, Chiapas state, on wood in evergreen rain forest (ITCV;JDR).

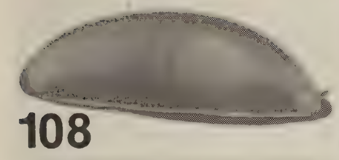
NOTES: Our concept of *X. feejeensis* is generally that of Dennis (1956). Most collections could probably be accommodated as *X. corniformis* (Fr.) Fr. (see Laessøe, 1988).

Xylaria sp. aff. *feejeensis* Fig. 52.

Stromata unbranched or branched, cylindrical to irregular, terete to flattened, on abruptly narrowed short to long stipes, 1.5-3.5 cm total length X 2.5-4 mm diam; externally dull black with remains of a lighter colored outer layer; internally whitish. Texture hard. Surface rugose with cracks and verrucae. *Perithecia* 0.3-0.5 mm diam. Ostioles hemispherical. *Asci* eight- spored, cylindrical, long-stipitate, 112-150 µm total length X 5.5-7 µm broad, the spore-bearing part 57-80 µm long, with apical ring bluing in Melzer's iodine reagent, quadrate, 2 X 2 µm. *Ascospores* light brown to dark brown, unicellular, ellipsoid-inequilateral with broadly rounded or narrowly rounded ends, smooth, 9-10(-11) X 4-4.5(-5) µm, with straight germ slit full-length.

Figs. 108-122. 108-110. *Xylaria magniannulata*. 108. Ascospore with germ slit, X 940. 109. Ascospore appendage, X 4125. 110. Ascus apical ring. Arrow points to the apex of ring, X 940. 111,112. *Xylaria squamulosa*. 111. Ascospore with germ slit, X 940. 112. Ascus apical ring, X 940. 113. *Xylaria amphithele*. Ascus apical ring, X 2055. 114. *Xylaria* sp. SM 337. Ascospore with cellular appendage, X 750. 115,116. *Xylaria amphithele*. 115. Ascospore with noncellular appendages (arrows) X 3280. 116. Ascospore with germ slit, X 3280. 117-122. *Xylaria alata*. 117. Ascospore apex showing curled cellular appendage (arrow), X 10,000. 118. Ascospore with cellular appendages oriented in the "broad" dimension (arrows), X 3300. 119. Ascospore with cellular appendages oriented in the "narrow" dimension (arrows), X 3300. 120. Section of closely packed broad paraphyses, X 3300. 121. Ascospores, one showing cellular appendages in the "narrow" dimension (arrows), X 5000. 122. Ascospore with cellular appendages oriented in the "broad" dimension, X 7000.

Figs. 114,115,118,119,120 by darkfield phase microscopy. Figs. 121,122 by scanning electron microscopy. Other figs. by brightfield microscopy. Figs. 110,112,113 from mounts in Melzer's reagent. Other material examined by light microscopy from water mounts.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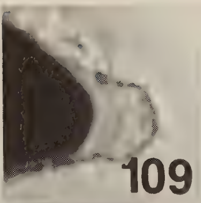
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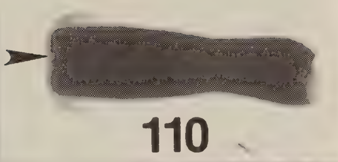
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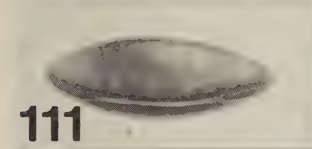
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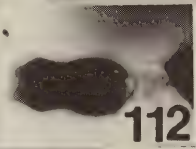
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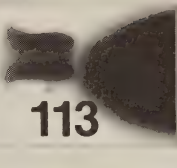
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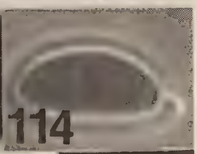
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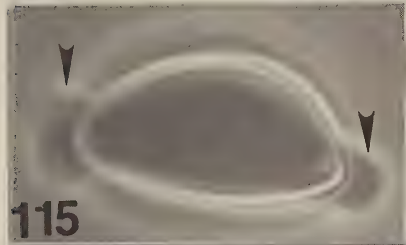
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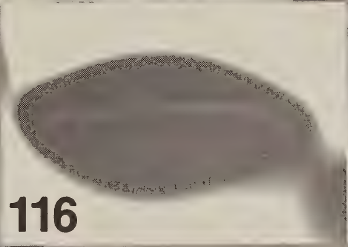
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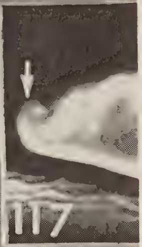
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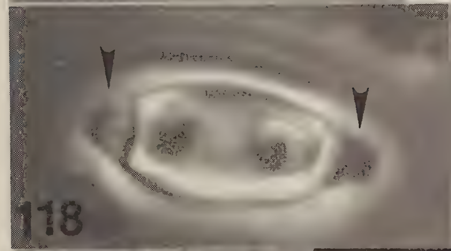
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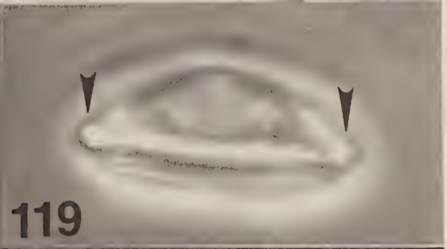
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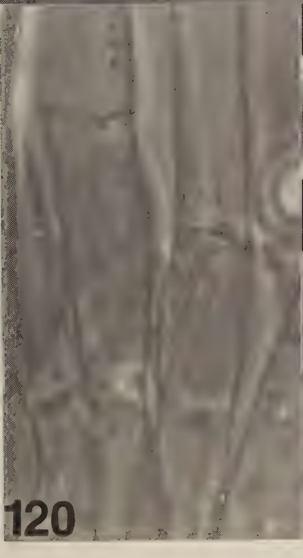
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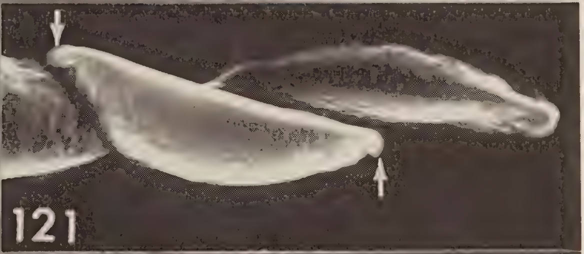
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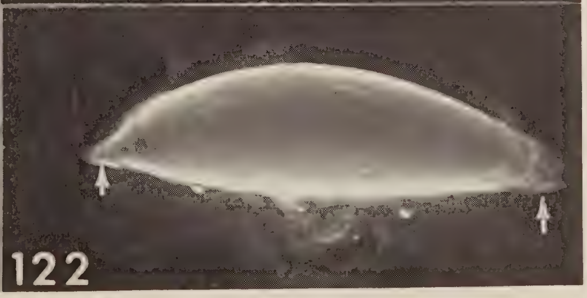
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SPECIMEN EXAMINED: San Martín 47, 8.XI.1986, "Los Troncones", Ciudad Victoria municipality, Tamaulipas state, on wood along stream (ITCV).

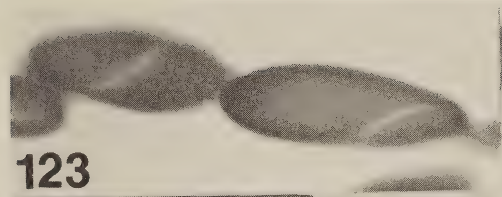
NOTES: This fungus probably represents a small-stromatal form of *X. feejeensis*. See notes on *X. feejeensis* herein.

Xylaria gracillima (Fr.) Fr., *Nova Acta Regiae Soc. Sci. Upsal. (ser. 3)* 1, p. 128. 1851.
Figs. 37,38,144,145.

Stromata unbranched or branched, prostrate or upright, each stroma consisting of a rachis bearing scattered to crowded, naked perithecia, extended upward into short or long acute apex and downward into a short or long tomentose stipe, 3-12 cm total length X 1-3 mm diam. Externally black; internally white. Texture soft. Surface smooth except for naked perithecia. *Perithecia* 0.4-0.8 mm diam. Ostioles papillate. *Asci* eight-spored, cylindrical, long-stipitate, 128-165 μm total length X

Figs. 123-144. 123. *Xylaria longipes* var. *tropica*. Ascospores showing portions of germ slit, X 2055. 124-126. *Xylaria uniapiculata*. 124. Ascospores, one with germ slit, X 2055. 125. Ascospore with cellular appendage (arrow), X 1800. 126. Ascus apical ring, X 2000. 127-130. *Xylaria guazumae*. 127. Ascospore with germ slit, X 2055. 128. Ascospore, X 2055. 129. Ascus apical ring, X 2000. 130. Ascospore with noncellular appendages (arrows), X 1800. 131-133. *Xylaria claviceps*. 131. Ascospores, X 2055. 132. Ascospore with germ slit, X 2055. 133. Ascus apical ring, X 2000. 134-136. *Xylaria scabriclavula*. 134. Ascus apical ring, X 2000. 135. Ascospores, X 2055. 136. Ascospore with germ slit, X 2055. 137-139. *Xylaria juruensis*. 137. Ascospore with germ slit, X 2055. 138. Ascospore, X 2055. 139. Ascus apical ring, X 1560. 140-142. *Xylaria* cf. *laevis*. 140. Ascospore with slit, X 2055. 141. Ascospore, X 2055. 142. Ascus apical ring, X 2055. 143. *Xylaria* sp. aff. *bambooensis*. Ascospores, X 2055. 144. *Xylaria gracillima*. Ascospore with germ slit, X 2055.

Figs. 125,130 by darkfield phase microscopy. All other figs. by brightfield microscopy. Figs. 126,129,133, 134,139,142 from mounts in Melzer's reagent. Other material examined in water mounts.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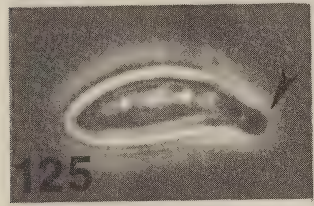
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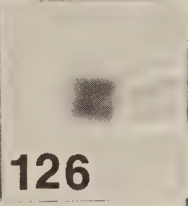
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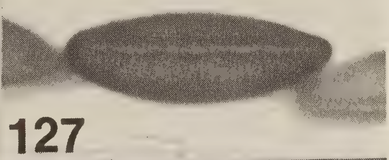
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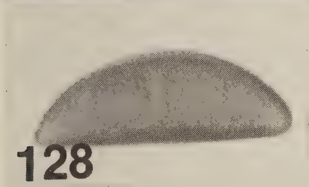
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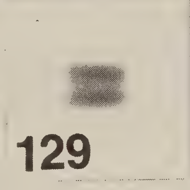
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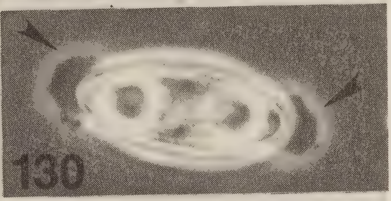
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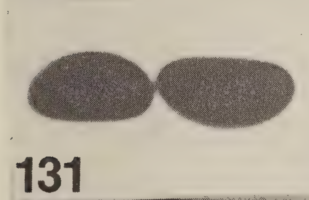
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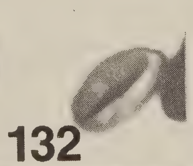
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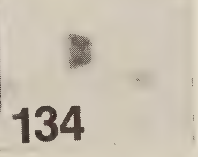
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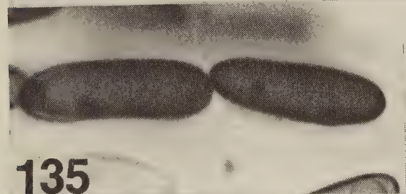
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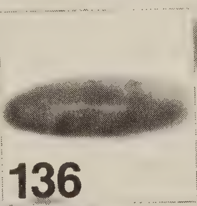
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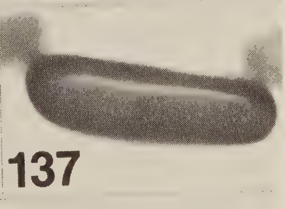
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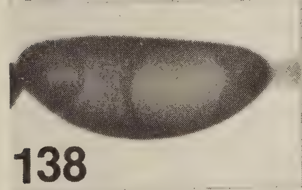
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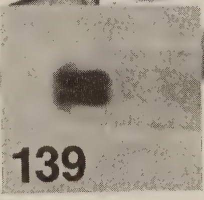
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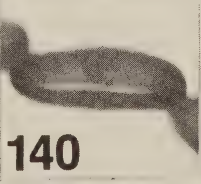
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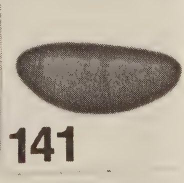
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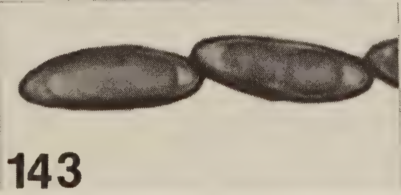
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144

6-7.5 µm broad, the spore-bearing part 74-84 µm, with apical ring bluing in Melzer's iodine reagent, rectangular, 4-4.5 µm high X 2.5-3 µm broad. Ascospores brown to dark brown, unicellular, ellipsoid-inequilateral with broadly or narrowly rounded ends, smooth, 10-12(-13) X 4-5 µm, with straight germ slit less than spore-length.

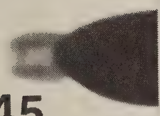
SPECIMENS EXAMINED: San Martín 111, 9.XII.1986, Felipe Carrillo Puerto, Quintana Roo state, on material buried in soil in median subdeciduous rain forest (ITCV); San Martín 210, 16.VII.1987, Gómez Farías, Tamaulipas state, on material buried in soil in median subdeciduous rain forest (ITCV;JDR).

NOTES: Dennis (1970) considered this species a synonym of *X. inaequalis* Berk. & Curt. (as *Xylosphaera*). Our concept of *X. inaequalis* is of a somewhat more robust fungus with perithecia placed more or less on one or two sides of a rachis, much as illustrated by Dennis (1956). Miller's photos of *X. gracillima* (in possession of JDR) show fusoid ascospores. According to Lloyd (1918A) material of J. Rick has fusiform spores 24-28 X 6 µm; Lloyd accepted Rick's interpretation of the species. Clearly, the Xylarias with naked perithecia on a narrow rachis need to be studied as a group before their individual taxonomic and nomenclatural status becomes clear.

Xylaria grammica (Mont.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 128. 1851. Figs. 40,41.

Figs. 145-155. 145. *Xylaria gracillima*. Ascus apical ring, X 2055. 146-148. *Xylaria* aff. *enterogena*. 146. Ascospore with germ slit, X 2055. 147. Ascus apical ring, X 1560. 148. Ascospore, X 1560. 149,150. *Xylaria kegeliana*. 149. Ascospore with portion of spiralling germ slit, X 1560. 150. Ascus apical ring, X 2055. 151-153. *Xylaria* cf. *nigrescens*. 151. Ascospore with germ slit, X 1560. 152. Ascus apical ring, X 1560. 153. Ascospore, X 1560. 154,155. *Xylaria pallide-ostiolata*. 154. Ascospore with germ slit, X 2055. 155. Ascus apical ring, X 1560.

All figs. by brightfield microscopy. Figs. 145,147, 150,152,155 from mounts in Melzer's reagent. Other material examined in water mounts.



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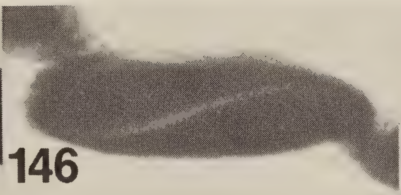

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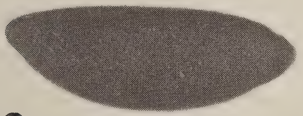

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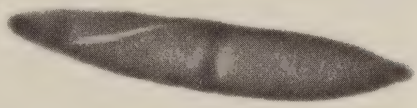

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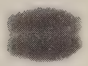

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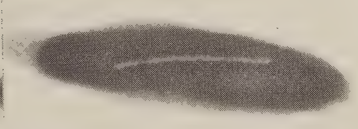

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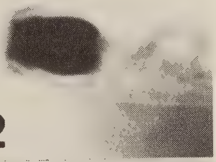

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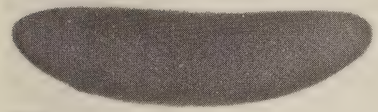

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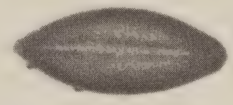

154

155

Stromata unbranched or branched toward base, cylindric-clavate to cylindric-fusiform, with apices rounded and fertile or acute and sterile, on short to long stipes originating from pannose bases, 7-13 cm total length X 5-7 mm diam; externally at first whitish, darkening in such a manner that darker areas and remaining whitish areas appear as vertical stripes; internally whitish to yellowish, becoming hollow. Surface smooth except for stripes. Perithecia 0.4-1.2 mm diam. Ostioles punctate, in dark stripes. Asci eight-spored, cylindrical, long-stipitate, at least 150-162 µm total length X 5-7 µm broad, the spore-bearing part ca. 70 µm long, with apical ring bluing in Melzer's iodine reagent, rectangular, 3 µm high X 1.5-2 µm broad. Ascospores brown to dark brown, unicellular, ellipsoid-inequilateral with narrowed to somewhat pinched ends, smooth, (9.5-)10-12 (-12.5) X (4.5-)5-5.5 µm, with straight germ slit spore-length.

SPECIMENS EXAMINED: San Martín 325, 23.VIII.1987, Ejido Loma Bonita, Ocosingo municipality, Chiapas state, from wood in evergreen rain forest (ITCV,JDR); García 4891, IX.1985, "El Cielo" ranch, Gómez Farías municipality, Tamaulipas state, on wood in cloud forest (ITCV); *Xelhuantzi, M. S. 100, 4.XI.1978, Cerro del Tepozteco, Tepoztlán, Morelos state, on wood (JDR;XAL).

NOTES: Dennis (1958) believed that specimens differing from X. grammica in having thinner stromata and acute sterile apices should be referred to X. venustula Sacc. We have both kinds of stromata in our collections and believe that they represent one and the same species. We refer to all of these intergrading forms as X. grammica. Cultural and other data bearing on this problem would be desirable. Typical X. grammica from México has been described and illustrated by Pérez-Silva (1975).

Xylaria guazumae San Martín & Rogers, sp. nov.
Figs. 53,54,127-130.

Stromata discoidea vel subglobosa vel globosa, constantia ex aggregatis peritheciorum plus minusve nudorum 1-2 mm diam, stipitibus capillaribus usque ad 5 cm longis, plerumque solitaria sed interdum caespitosa. Extus nigra; intus alba. Textura mollis. Superficies asperata a formis peritheciorum. Perithecia 0.5-0.7 mm diam. Asci saepe biseriate octospori, cylindrici, stipitati, 148-212 µm longitudine tota X 7-7.5 µm crassi, partibus sporiferis 100-132 µm, annulo apicali in liquore Melzeri cyanescente, oblongo, 2.8-3.2(-3.8) µm alto X 2-2.5(-3) µm crasso. Ascosporae brunneae, unicellulares, ellipsoideo-inaequilaterales cum late vel anguste rotundatis extremis, omni extremo cum rotundata hyalina noncellulari appendicula usque ad 5 µm longa X 5 µm crassa, leves, (14-)15-18(-19) X 5.5-6 µm, rima germinativa leviter minus quam longitudo sporae. Status anamorphosis ignotus.

Stromata discoid to subglobose to globose, composed of aggregations of more or less naked perithecia 1-2 mm diam, with hair-like stipes up to 5 cm long, usually solitary, but sometimes cespitose. Externally black; internally white. Texture soft. Surface roughened by perithecial contours. *Perithecia* 0.5-0.7 mm diam. Ostioles conical. *Asci* eight-spored, the spores often arranged in a biseriate manner, cylindrical, stipitate, 148-212 µm total length X 7-7.5 µm broad, the spore-bearing part 100-132 µm, with apical ring bluing in Melzer's iodine reagent, rectangular, 2.8-3.2(-3.8) µm high X 2-2.5(-3) µm broad. *Ascospores* brown, unicellular, ellipsoid-inequilateral with broadly or narrowly rounded ends, each bearing a rounded hyaline noncellular appendage up to 5 µm long X 5 µm broad, smooth, (14-)15-18(-19) X 5.5-6 µm, with straight germ slit slightly less than full-length. Anamorph unknown.

SPECIMENS EXAMINED: San Martín 208, 1987, Gómez Farías, Tamaulipas state, on fallen fruits of *Guazuma ulmifolia* Lam. ("aquiche" or "guazima") in median subdeciduous rain forest (HOLOTYPE:ITCV; ISOTYPE:JDR); San Martin 343, 2.VIII.1987, Ocampo, Tamaulipas state, on fallen fruits of *Guazuma ulmifolia* Lam. in low deciduous rain forest (ITCV;JDR).

NOTES: The present fungus resembles *X. heloidea*, but ascospores of that species do not bear conspicuous secondary appendages.

Xylaria guyanensis (Mont.) Fr., Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 127. 1851. Figs. 42,43.

Stromata clavate with rounded fertile apices, on short stipes with discoid bases, 4-5 cm total length X 0.8-1.2 cm diam; externally gray-yellowish, becoming blackened; internally white to yellowish, becoming hollow.

Texture hard to very hard but fragile. Surface smooth except for minute cracks and ostioles. *Perithecia* 0.8-2 mm diam. *Asci* not intact, cylindrical, eight-spored, the spore bearing part 110-120 X 5.5-6 µm, with apical ring bluing in Melzer's reagent, quadrate to almost rectangular, 2.8-3 µm high X 2-3 µm broad. *Ascospores* brown, unicellular, ellipsoid-inequilateral to navicular, with rounded ends, smooth, (14-)15-17.5 X 4.5-6(-7) µm, with straight germ slit spore-length.

SPECIMEN EXAMINED: García 2734, 10.XI.1982, from Catemaco to Montepío Balzapote, Veracrúz state, on wood in evergreen rain forest (ITCV,JDR)

NOTES: *Xylaria guyanensis* is much like *X. poitei*, but has generally smaller stromata and larger ostiolar discs. *Xylaria poitei* has an easily identifiable conidial state that is produced in culture. It is hoped that future collections of *X. guyanensis* can be cultured and compared with those of *X. poitei* (Rogers & Callan, 1986B). Pérez-Silva (1975) described and illustrated *X. guyanensis* from México. She gave ascospores as 18-20.4 X 6-7 µm, considerably longer than reported here. Dennis (1956) reported ascospores of South American material as 14-21 X 5-8 µm.

Xylaria ianthino-velutina (Mont.) Fr., Nova Acta Regiae *Soc. Sci. Upsal.* (ser. 3) 1, p. 128. 1851.

Stromata unbranched or branched, cylindrical to irregular, bearing more or less naked perithecia, terete to flattened, with acute sterile apices, on ill-defined stipes, 2-13 cm total length X 1.5-2.5 mm diam; externally reddish brown to black, tomentose over all; internally white. Texture rather soft. Surface roughened with perithecial elevations and tomentum. *Perithecia* 0.3-0.6 mm diam. Ostioles finely papillate. *Asci* eight-spored, cylindrical, stipitate, 85-120 µm total length X 5-6 µm broad, the spore-bearing part 60-90 µm, with apical ring bluing in Melzer's iodine reagent, rectangular, 2-2.5 µm high X 1-2 µm broad. *Ascospores* light brown to dark brown, unicellular, ellipsoid-inequilateral with rounded to narrowly rounded ends, smooth, 10-12(-13) X 4-5 µm, with straight germ slit spore-length.

SPECIMENS EXAMINED: García-Alanís 60, XI.1987, Aldama, Tamaulipas state, on fallen fruits of *Pithecellobium* *flexicaule* (Benth.) Coult. ("maguacata") in mixed tall scrub-low subdeciduous rain forest (ITCV): Guevara 724, 1986, "San Miguel" ranch, José María Morelos municipality, Quintana Roo state, on pods in low subdeciduous rain forest (ITCV); San Martín 22, 14.X.1986, Gómez Farías, Tamaulipas state, on pod in median subdeciduous rain forest (ITCV). San Martin 377, IX.1987, (same data as San Martín 22, above), on fallen fruits of *Guazuma ulmifolia* Lam. (ITCV;JDR).

NOTES: These collections generally fit our concept of *X. ianthino-velutina*. Typical material has dark ascospores with evident germ slits (Dennis, 1956; Rogers, 1979). Some material has pale ascospores with less conspicuous germ slits, resembling in some respects *X. magnoliae*. That species, however, appears confined to *Magnolia* (Rogers, 1979). Discussions of *X. ianthino-velutina* and allied forms or taxa with pale ascospores are in Rogers (1979) and Rogers et al. (1988).

It is perhaps noteworthy that *Guazuma ulmifolia* is herein reported as a substrate for *X. ianthino-velutina*, a species usually reported from legume pods. Elsewhere herein, *X. aristata* and *X. quazumae* are also reported from fruits of *G. ulmifolia*. It is becoming evident that *G. ulmifolia* fruits represent a substrate for diverse and, perhaps ultimately numerous, species of *Xylaria*.

Xylaria cf. *inaequalis* Berk. and Curt., J. Linn. Soc. Bot. 10:382. 1869.

Stroma branched, irregular, flattened, bearing a few more or less naked perithecia on one side of a branch, with acute sterile apices, on long pubescent stipe, 2 cm total length X 1.5 mm diam; externally brownish black, internally yellowish. Texture soft. Surface roughened by perithecial contours and pubescence of stipe. *Perithecia* 0.2-0.4 mm diam. Ostioles more or less umbilicate. *Asci* eight-spored, cylindrical, long-stipitate, 116-127 µm total length X 5.5-6 µm broad, the spore-bearing part 59-66 µm, with apical ring bluing in Melzer's iodine reagent, quadrate, 1.5-2 X 1.5-2 µm. *Ascospores* brown to dark brown, unicellular, ellipsoid-inequilateral with mostly broadly rounded ends, smooth, 10-11(-11.5) X 4-4.5(-5) µm, with straight germ slit spore-length.

SPECIMEN EXAMINED: San Martín 99, 8.VII.1986, Ejido La Unión, Othón P. Blanco municipality, Quintana Roo state, on fallen fruit of *Swietenia macrophylla* King ("caoba") in evergreen rain forest (ITCV).

NOTES: This fungus is represented by only one stroma. It seems much like *X. inaequalis* as depicted by Dennis (1956) in the asymmetrical insertion of perithecia. See also "Notes" on *X. gracillima* herein.

Xylaria juruensis P. Henn., Hedwigia 43:262. 1904.
Figs. 45,46,137-139.

Stromata unbranched or branched, cylindrical to irregular, terete to compressed, bearing more or less naked perithecia, with short to long hair- like apiculi, on long thin stipe, 1.5-3 cm total length X 1 mm diam; externally blackish with gray peeling layer, pubescent overall; internally white. Texture fairly hard. Surface roughened by peeling layer, perithecial contours, and pubescence. *Perithecia* 0.2-0.6 mm diam. Ostioles umbilicate to slightly raised. *Asci* eight-spored, the spores usually arranged in a partly biseriate manner, cylindrical, stipitate, 127-152 µm total length X 6-7(-10) µm broad, the spore-bearing part 82-102 µm, with apical ring bluing in Melzer's iodine reagent, rectangular, 5-7 µm high X 2-4 µm broad. *Ascospores* brown, unicellular, ellipsoid-inequilateral with rounded to acute ends, smooth, 14.5-17(-18) X 5-5.5(-6.5) µm, with straight germ slit slightly less than spore-length.

SPECIMEN EXAMINED: San Martín 293, VIII.1987, Ejido La Unión, Othón P. Blanco municipality, Quintana Roo state, on wood in median subdeciduous rain forest (ITCV;JDR).

NOTES: The type was from monocot material from an Amazon jungle (Hennings, 1904). Rogers & Samuels (1987) described a collection from a palm midrib from Sulawesi. The present material is from dicot wood and fits Hennings' description well (Hennings, 1904). Carroll (1964) illustrated a spiralling germ slit for *X. juruensis*.

Xylaria kegeliana (Lév.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 125. 1851; sensu J. H. Miller.
Figs. 44,47,149,150.

Stromata unbranched or branched, cylindrical to clavate with abrupt acute sterile apices, on short to long stipes, 4-12 cm total length X 4-7 mm diam; externally dirty white to light tan with black ostioles, often appearing vaguely longitudinally striped, with blackish stipes; internally white, becoming hollow. Texture fairly hard. Surface smooth except for ostiolar papillae and minute cracks. *Perithecia* 0.4-1.2 mm diam. Ostioles papillate, often in vertical rows. *Asci* eight-spored, cylindrical, long-stipitate, 317-337 µm total length X 7.5-8 µm broad, the spore-bearing part 177-192 µm, with apical ring bluing in Melzer's iodine reagent, rectangular, 5-6 µm high X 3-3.5 µm broad. *Ascospores* brown, unicellular, ellipsoid-inequilateral to navicular, with narrow to abruptly pinched ends, smooth, (27-)28-33.5(-35) X 6-7.5(-8) µm, with spiralling germ slit spore-length.

SPECIMEN EXAMINED: San Martín 36, X.1986, Gómez Farías, Tamaulipas state, on wood in median subdeciduous rain forest (ITCV).

NOTES: This material fits exactly J. H. Miller's concept of *X. kegeliana*. Unpublished photographs of Lloyd material by Miller (in possession of JDR) show stromata and ascospores like those described and depicted herein. Dennis (1956), discussing *X. kegeliana*, wrote, "In stature this recalls *X. grammica*, in color and spores it resembles *X. dealbata*." The present fungus greatly resembles *X. grammica* in gross morphology and somewhat resembles it in the color and vague vertical striping of the stroma. It does not, however, resemble *X. dealbata* either in color or ascospore morphology. Rogers et al. (1988) described a fungus from Venezuela that was tentatively considered to be *X. kegeliana*. That fungus had coloration much more like *X. dealbata* than the fungus discussed herein. Its ascospores are much like the fungus discussed herein in general morphology, but are smaller and have a short, nonspiralling germ slit. The relationship of these distinct fungi to one another is unknown.

Xylaria cf. *laevis* Lloyd, Xylaria Notes 1, Mycol. Writ.
5:8. 1918. Figs. 48,140-142.

Stromata unbranched or branched at base, with rounded fertile apices, on short or long fluted stipes arising from pannose base, 1.6-2.3 cm total length X 4-6 mm diam, externally copper-colored, becoming blackish; internally white, becoming hollow. Texture hard. Surface smooth except for fine wrinkles and ostioles. *Perithecia* 0.3-0.5 mm diam. Ostioles finely papillate. *Asci* eight-spored, cylindrical, long-stipitate, 105-195 µm total length X 5-6 µm broad, the spore-bearing part 50-69 µm long, with apical ring bluing in Melzer's iodine reagent, quadrate to rectangular, 2-3 µm high X 2 µm broad. Ascospores brown, unicellular, ellipsoid-inequilateral with broadly or narrowly rounded ends, smooth, (8.5-)9-11(-12) X 4-5 µm, with germ slit straight, spore-length.

SPECIMEN EXAMINED: Chacón 111, XI.1987, Ejido Loma Bonita, Llera municipality, Tamaulipas state, on wood in low subdeciduous forest (ITCV,JDR).

NOTES: This fungus is close to X. cubensis, differing primarily in the slightly longer (average) ascospores with conspicuous germ slits. It is probably X. laevis, which was described as a small-spored form of X. nigrescens.

Xylaria cf. longiana Rehm, Ann. Mycol. 2:175. 1904.
Figs. 88,89.

Stromata unbranched or branched from base or above, cylindrical, terete or flattened, bearing conspicuous perithecia, with acute sterile apices, with ill-defined stipes, 2-6 cm total length X 2-4 mm diam; externally black sometimes with remains of white peeling outer layer; internally white with black medulla. Texture fairly soft. Surface of stipe and usually fertile part conspicuously tomentose, roughened by perithecial elevations and peeling outer layer. Perithecia 0.2-0.5 mm diam. Ostioles umbilicate to somewhat papillate. Asci eight-spored, cylindrical, long-stipitate, 102-136 µm total length X 5-6 µm broad, the spore-bearing part 46-70 µm long, with apical ring bluing in Melzer's iodine reagent, quadrate, 1.5-2.5 X 1.5-2.5 µm. Ascospores brown to dark brown, unicellular, ellipsoid-inequilateral with broadly or narrowly rounded ends, smooth (7.3-)9-10(-11) X 4-5(-5.5) µm, with straight germ slit spore-length or nearly so.

SPECIMENS EXAMINED: Chacón-Jiménez 360, XI.1987, Ejido Julilo, Gómez Farías municipality, Tamaulipas state, on wood in Pinus-Quercus forest (ITCV;JDR); García Alanís 10, 1987, Ejido Conrado Castillo, Hidalgo municipality, Tamaulipas state, on Quercus sp. wood in Pinus-Quercus forest (ITCV;JDR); *Vargas, J. 284, 12.VIII.1969, 20 km from Teotitlán, road to Huautla de Jiménez, Oaxaca state, on wood (JDR;XAL).

NOTES: These collections are much like *X. longiana*, but the heavy tomentum on the clavae and the stipes of the Chacón-Jiménez and Alanis specimens is unusual in our experience. Rehm remarked on the tomentose stipe in the original description. Type material is from *Quercus* from Texas. We have not examined it. What we are calling *X. longiana* here is often considered to be a small-spored form of *X. hypoxylon* and has the same general morphology as that species. Pérez-Silva (1975) reported typical *X. hypoxylon* on the basis of immature specimens and cultures. We have not encountered typical (large-spored) *X. hypoxylon*, but would be surprised if it were not extant and, indeed, common in northern parts and/or high altitudes.

Xylaria longipes Nits., Pyrenomycetes Germanici, p. 14. 1867.
Figs. 49,50.

Stromata unbranched or branched, cylindrical to clavate to spathulate, with rounded fertile apices, on short to long stipes, 4-7 cm total length X 5-9 mm diam; externally dark brown with areas of sloughing whitish scales; internally white. Texture woody. Surface roughened with wrinkles, verrucae, and ostiolar papillae. *Perithecia* 0.3-0.8 mm diam. Ostioles papillate. *Asci* eight-spored, cylindrical, stipitate, 151-183 µm total length X 6-7 µm broad, the spore-bearing part 106-116 µm, with apical ring bluing in Melzer's iodine reagent, quadrate to rectangular, 2-2.5 µm high X 2-2.7 µm broad. *Ascospores* brown to dark brown, unicellular, ellipsoid-inequilateral to navicular with narrowed ends, smooth, 13-16 X 4-5(-5.5) µm, with spiralling germ slit full-length.

SPECIMEN EXAMINED: Chacón 384, XI.1987, Ejido Julilo, Gómez Farías municipality, Tamaulipas state, on wood in cloud forest (ITCV;JDR); San Martín 3, X.1985, "El Cielo" ranch, Gómez Farías municipality, Tamaulipas state, on wood in cloud forest (ITCV;JDR).

NOTES: *Xylaria longipes* is widely considered to be an inhabitant of more northern parts of the temperate zone. It is widely associated with *Acer* spp. in North America and Europe. Dennis (1956) reported one collection from Brazil and, according to him, J. H. Miller reported a collection from Venezuela. Unfortunately, our material could not be cultured and compared with cultures from elsewhere (see Rogers, 1983).

Xylaria longipes Nits. var. tropica San Martín & Rogers, var. nov.
Typical variety in Pyrenomycetes Germanici, p. 14. 1867. Figs. 51,123.

A varietate typica differt in stromatibus cavis, in superficie rimosa, et in ascis brevioribus.

Differs from typical variety in the hollow stromata, in the cracked surface, and in the shorter asci.

Stromata cylindrical to clavate with rounded fertile apices, with short to long stipes, 3.2-6.2 cm total length X 3-7 mm broad; externally blackish with sloughing brown scales associated with cracking; internally white, becoming hollow. Texture woody. Surface roughened with wrinkles, scales, and ostiolar papillae. Perithecia 0.3-0.7 mm diam. Ostioles conical to hemispherical, often coated with white granular material. Asci eight-spored, cylindrical, stipitate, 150-170 µm total length X 6-7.5 µm broad, the spore-bearing part 90-95 µm long, with apical ring bluing in Melzer's iodine reagent, quadrate to rectangular, 2-3 µm high X 2-2.5 µm broad. Ascospores brown, unicellular, ellipsoid-inequilateral to navicular with narrow ends, smooth, (13-)14-16 X 5-6 µm, with spiralling germ slit spore-length.

SPECIMEN EXAMINED: San Martín 327, VIII.1987, Ejido Bocade Chajul, Ocosingo municipality, Chiapas state, on wood in evergreen rain forest (ITCV:JDR).

NOTES: This fungus appears to be a form of X. longipes, differing from typical material in becoming hollow, in the cracking of the surface, and in the shorter asci. The white material around ostioles is noteworthy, but is not a constant feature. It is accordingly described as a new variety.

Xylaria magniannulata San Martín & Rogers, sp. nov. Figs. 55,56,108-110.

Stromata non ramosa vel ramosa super stipites, cylindracea, peritheciis plus minusve immersis, apicibus acutis sterilibus, in brevibus vel longis stipitibus, 4 cm longa X 1.5-3 mm crassa; extus atra, superficie cinereo-glaucescenti; intus alba. Textura plus minusve mollis. Superficies asperata formis peritheciorum et papillis ostiolorum magnarum. Perithecia 0.5-0.7 mm diam. Ostiola conica, valde conspicua. Asci saepe biseriate octospori, cylindrici, breviter stipitati, 206-250 μm longitudine tota X 17-24 μm crassi, partibus sporiferis 182-230 μm, annulo apicali in liquore Melzeri cyanescente, cylindraceo, 21-40 μm alto X 8.5-11 μm crasso. Ascosporae brunneae, unicellulares, ellipsoideo-inequilaterales cum rotundatis extremis, totae ab acellularibus appendiculis hyalinis et vaginis hyalinis indutae, 34-45(-47) X (14-) 15-20(-21) μm, rima germinativa recta per longitudinem sporae. Status anamorphosis ignotus.

Stromata unbranched or branched above stipes, cylindrical, bearing partly immersed perithecia, with acute sterile apices, on short to long tomentose stipes, 4 cm high X 1.5-3 mm diam; externally black with grey bloom; internally white. Texture fairly soft. Surface rough with perithecial contours and large ostiolar papillae. Perithecia 0.5-0.7 mm diam. Ostioles conical, very conspicuous. Asci eight-spored, the spores arranged in partly biseriate or uniseriate manner, cylindrical, short-stipitate, 206-250 μm total length X 17-24 μm broad, the spore-bearing part 182-230 μm, with apical ring bluing in Melzer's iodine reagent, cylindrical, 21-40 μm high X 8.5-11 μm broad. Ascospores dark brown, unicellular, ellipsoid-inequilateral with rounded ends, bearing hyaline noncellular appendages and hyaline sheath, smooth, 34-45 (-47) X (14-)15-20(-21) μm, with straight germ slit spore-length.

SPECIMEN EXAMINED: San Martín 292, VIII.1987, Ejido La Unión, Othón P. Blanco municipality, Quintana Roo state, on soil, possibly associated with insect nests, in median subdeciduous rain forest (HOLOTYPE:ITCV).

NOTES: This fungus is notable in the large size of ascospores and the massive apical ascus ring, among the largest known. It is named for this latter feature, i.e., the ascus is large-ringed. The large coarse ostiolar papillae and the ascospore sheath and noncellular appendages are also highly characteristic. Everything considered, X. magniannulata is a highly distinctive fungus.

Xylaria magnoliae Rogers, Canad. J. Bot. 57:941. 1979.
Figs. 57,58.

Stromata branched or unbranched, cylindrical to irregular, tomentose, bearing scattered to crowded more or less naked perithecia, with acute sterile apices, on short to long fluted tomentose stipes, 4-7 cm total length X 1.5-3.5 mm diam; externally dull blackish; internally yellowish. Texture woody. Surface roughened by perithecial contours and tomentum. Perithecia 0.3-0.4 mm diam. Ostioles papillate. Asci eight-spored, the spores arranged in uniseriate or partly biseriate manner, cylindrical, stipitate, 110-150 µm total length X 5-8 µm broad, the spore-bearing part 75-85 µm, with apical ring bluing in Melzer's iodine reagent, quadrate to rectangular, 1.5-2.2 µm high X 1-1.5 µm broad. Ascospores subhyaline to yellowish, unicellular, ellipsoid-inequilateral with narrow to more or less acute ends, smooth, 12-16(-17) X 3-5 µm, lacking obvious germ slit.

SPECIMEN EXAMINED: San Martín 254, IX.1987, Ejido Conrado Castillo, Hidalgo municipality, Tamaulipas state, on fallen fruits of Magnolia schiedeana Schl. in cloud forest (ITCV;JDR).

NOTES: This fungus seems typical of X. magnoliae, as described by Rogers (1979). Somewhat similar fungi have been found on non-Magnolia hosts in South America (see Rogers et al., 1988).

Xylaria maitlandii (Dennis) D. Hawksw., Trans. Brit. Mycol. Soc. 61:199. 1973. Figs. 59,60.

Stromata unbranched or branched, cylindrical bearing immersed perithecia, with acute sterile apices, on short to long pubescent stipes, up to 3 cm total length X 1-2 mm broad; externally black with brown peeling outer layer and slight pubescence; internally at first white, becoming brown and then hollow. Texture hard. Surface smooth except for peeling layer and pubescence. Perithecia 0.3-0.5 mm diam. Ostioles umbilicate to slightly raised. Asci eight-spored, poor condition in this material, the spore-bearing part 78-83 X 5-6 µm, with apical ring bluing in Melzer's iodine reagent, quadrate, 2 X 2 µm. Ascospores brown, unicellular, ellipsoid-inequilateral with broadly or narrowly rounded ends, smooth, 11-12(-12.5) X (4-)5-5.5 µm, with straight germ slit less than spore-length.

SPECIMEN EXAMINED: San Martín 320, VIII.1987, Ejido Boca de Chajul, Ocosingo municipality, Chiapas state, on wood in evergreen rain forest (ITCV;JDR).

NOTES: Our material looks much like *X. maitlandii*, described by Dennis (as *Xylosphaera*) from Africa (1958) except that the fertile part is not as hairy as type material.

Xylaria cf. *mellisii* (Berk.) Cooke var. *nuda* (Dennis) D. Hawksw., Trans. Brit. Mycol. Soc. 61:200. 1973. Fig. 61.

Xylosphaera mellisii (Berk.) Dennis var. *nuda* Dennis, Rev. Biol. 1:188. 1958.

Stromata unbranched or branched, cylindrical bearing more or less naked perithecia, with acute sterile apices, on short to long stipes, 3-5 cm total length X 2-3 mm diam; externally blackish with whitish to brown outer peeling layer; internally white to cream. Texture hard. Surface roughened by perithecial contours and peeling layer. *Perithecia* 0.4-0.8 mm diam. Ostioles umbilicate to finely papillate. *Asci* eight-spored, cylindrical, stipitate, 157-200 µm total length X 6-7 µm broad, the spore-bearing part 97-105 µm, with apical ring bluing in Melzer's iodine reagent, quadrate to rectangular, 2.5-3.5 µm high X 2-2.5 µm broad. *Ascospores* brown, unicellular, ellipsoid-inequilateral with rounded ends, smooth, (12.5-) 13-16(-18) X 5-6 µm, with straight germ slit spore-length.

SPECIMEN EXAMINED: San Martín 218, 16.VII.1987, Gómez Farias, Tamaulipas state, on wood in median subdeciduous rain forest (ITCV;JDR).

NOTES: Our material is much as described by Dennis (1958) from Africa, except that the fertile parts of our fungus are longer (2 cm in some cases). Dennis considered *X. arbuscula* to be a synonym of *X. mellisii*. We have not evaluated this complicated situation and prefer to wait until the entire group of species can be studied and, preferably, cultured. We are, however, on shaky taxonomic and nomenclatural ground in using both *X. mellisii* and *X. arbuscula* herein.

Xylaria cf. *microceras* (Mont.) Fr., Nova Acta Regiae Soc. Upsal. (ser. 3) 1, p. 128. 1851. Figs. 62,63.

Stromata cylindrical bearing inconspicuous to conspicuous perithecial undulations, with long acute sterile apices, on short glabrous stipes, 1.5-3 cm total length X

2 mm diam; externally blackish with white peeling outer layer; internally white. Texture fairly hard. Surface smooth except for perithecial contours and peeling layer. *Perithecia* 0.3-0.6 mm diam. Ostioles slightly raised. *Asci* eight-spored, cylindrical, long-stipitate, 127-178 µm total length X 5-6 µm broad, the spore-bearing part 67-78 µm, with apical ring bluing in Melzer's iodine reagent, quadrate, 2 X 2 µm. *Ascospores* brown to dark brown, unicellular, ellipsoid-inequilateral with rounded ends, smooth, (9-)10-11 X 4-4.5(-5) µm, with straight germ slit less than full-length.

SPECIMEN EXAMINED: San Martín 219, Gómez Farías, Tamaulipas state, on wood in median subdeciduous rain forest (ITCV).

NOTES: Our material is much like *X. coccophora* reported herein but has slightly smaller ascospores. It might be more logically referred to *X. coccophora* because of the great resemblance of the stromata to those of that species (see Dennis, 1956; Rogers et al., 1988).

Xylaria multiplex (Kunze) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 127. 1851; sensu Dennis, Kew Bull. 1956:416. 1956. Figs. 64,65.

Stromata unbranched or branched, solitary to cespitose, cylindrical bearing perithecia partially immersed, with acute sterile apices, on short or long more or less pubescent stipes often arising from pannose bases, 1-5.5 cm total length X 1-2 mm diam; externally blackish with dark brown peeling outer layer; internally white, often black at center. Texture hard. Surface smooth to undulate to nodulose from perithecial contours, sometimes with scattered hairs. *Perithecia* 0.3-0.5 mm diam. Ostioles more or less punctate. *Asci* eight-spored, cylindrical, stipitate, 109-142 µm total length X 5-6 µm broad, the spore-bearing part 65-74 µm, with apical ring bluing in Melzer's iodine reagent, quadrate, 1.5-2 X 1.5-2 µm. *Ascospores* brown, unicellular, ellipsoid-inequilateral with broadly to narrowly rounded ends, smooth, 9-11(-12) X (3.5-)4-4.5(-5) µm, with straight germ slit spore-length.

SPECIMENS EXAMINED: *Brown, D. 50, 28.IX.1981, park on old Xalapa-Coatepec road, Veracrúz state, on wood (JDR;XAL); García 3195, El Cercado, Santiago municipality, Nuevo León state, on wood in submontane scrub with *Quercus* spp. (ITCV); *Martínez, D. 214, VII.1981, Estación Biológica Los Tuxtlas, Catemaco, Veracrúz state, on wood in evergreen rain forest (JDR;XAL); San Martín 150, 8.XII.1986, Ejido La Unión, Othón P. Blanco municipality, Quintana Roo state, on wood in submedian subdeciduous rain forest (ITCV;JDR); San Martín 204, X.1987, Ocampo, Tamaulipas state, on wood in low subdeciduous rain forest (ITCV;JDR).

NOTES: These collections generally fit our concept of X. multiplex. Stromata are not as robust as those sometimes encountered. Xylaria sp. (SM 39, 306) described herein might be a variant of this species. Pérez-Silva (1975) has described and illustrated this species from México.

Xylaria "muscula" Lloyd, Mycol. Notes 64, Mycol. Writ. 6:994. 1920. Figs. 66,67.

Stromata unbranched or several originating from common base, cylindrical with sterile or fertile apices, on short or long stipes, 0.5-3.5 cm total length X 1-3 mm diam; externally white with black ostioles; internally cream to light brown. Texture fairly hard. Surface slightly roughened by ostioles. Perithecia 0.2-0.4 mm diam. Ostioles umbilicate to slightly raised. Asci eight-spored, cylindrical, stipitate, 70-102 µm total length X 5-6 µm broad, the spore-bearing part 48-62 µm, with apical ring bluing in Melzer's iodine reagent, quadrate, 1-1.5 µm X 1-1.5 µm. Ascospores light brown, unicellular, ellipsoid-inequilateral with broadly rounded ends, smooth, 6-9(-10) X 3-3.5(-4) µm, with inconspicuous straight germ slit spore-length.

SPECIMENS EXAMINED: García 4348, 14.X.1986, Gómez Farías, Tamaulipas state, on wood in median subdeciduous rain forest (ITCV;JDR); San Martín 94, 7.XII.1986, San Felipe Bacalar, Othón P. Blanco municipality, Quintana Roo state, on wood in acahual (ITCV;JDR); San Martín 312, Ejido La Unión, Othón P. Blanco municipality, Quintana Roo state, on wood in median subdeciduous rain forest (ITCV;JDR).

NOTES: Our material greatly resembles Lloyd's description and photographs. According to Dennis (1956) type material of X. muscula is sterile. If this is true, a neotype should be selected and a proper description published.

Xylaria cf. nigrescens (Sacc.) Lloyd, Xylaria Notes 1, Mycol. Writ. 5:8. 1918. Figs. 68,69,151-153.

Stromata subglobose to clavate with rounded fertile apices, on short to long stipes, 2-6 cm total length X 5-10 mm broad; externally dirty brown to dull black, internally at first white, becoming hollow and inrolled. Texture hard to very hard. Surface smooth except for minor wrinkles and ostiolar papillae; stipes smooth or somewhat tomentose, with discoid bases. Perithecia 0.5-1 mm diam. Ostioles hemispherical, prominent. Asci eight-spored, cylindrical, stipitate but stipes mostly deteriorated, the spore-bearing part 129-133 μm long X 8-9 μm broad, with apical ring bluing in Melzer's iodine reagent, rectangular, 6-9 μm high X 4-5 μm broad. Ascospores light brown to dark brown, unicellular, ellipsoid-inequilateral to navicular, with ends smoothly rounded or abruptly pinched, smooth, 22-32(-35) X 6-8 μm, with germ slit straight to oblique, much less than spore-length.

SPECIMENS EXAMINED: San Martín 348 and 370, VIII. 1987, Ejido Boca de Chajul, Ocosingo municipality, Chiapas state, on wood in evergreen rain forest (ITCV;JDR). San Martín 355, VIII. 1987, "El Muneco", Ejido Loma Bonita, Ocosingo municipality, Chiapas state, on wood in evergreen rain forest (ITCV,JDR).

NOTES: Our material has a striking resemblance Lloyd's Fig. 1213 of Xylaria nigrescens (Lloyd, 1918B). His material, from Africa, was reported to have ascospores 20 X 8 μm. In a later publication another African collection is described as having ascospores 20-24 X 8 μm and illustrated (Fig. 1564) (Lloyd, 1919). Photographs of ascospores of Lloyd material taken by J. H. Miller (in possession of JDR) are much like those of our material. Thus, although ascospores of our material average larger than given by Lloyd and the fact that his material was from Africa, we believe it likely that our fungus is X. nigrescens.

Xylaria oxyacanthae Tul., Selecta Carpologia Fungorum 2, p. 15. 1863. Figs. 70,71.

Stromata unbranched or branched toward base, cylindrical to irregular, terete to somewhat flattened, with short acute sterile apices, on long tomentose stipes originating from pannose bases, 3-7 cm total length X

1-2.5 mm diam; externally blackish with gray to brown peeling outer layer; internally white to yellowish. Texture soft to woody. Surface roughened with wrinkles and perithecial contours. *Perithecia* 0.3-0.6 mm diam. Ostioles finely papillate. *Asci* eight-spored, cylindrical, long-stipitate, 114-164 µm total length X 6-7.5 µm broad, the spore-bearing part 65-80 µm, with apical ring bluing in Melzer's iodine reagent, quadrate, 1.5-2.5 X 1.5-2.5 µm. *Ascospores* brown to dark brown, unicellular, ellipsoid-inequilaterial with broadly or narrowly rounded ends, smooth, (9.5-)10-11.5(-12) X 5-5.5 µm, with straight germ slit full-length or nearly so.

SPECIMENS EXAMINED: San Martín 210A, 16.VII.1987, Gómez Farías, Tamaulipas state, on buried seeds of Vitaceae, in median subdeciduous rain forest (ITCV;JDR); San Martín 339, VIII.1987, (data same as above), on buried leguminous pod (ITCV).

NOTES: This material looks much like *X. oxyacanthae* from northern United States which occurs on *Crataegus* seeds (Stowell & Rogers, 1983). Material from northern USA has a paler peeling layer than the present material. The present material was found on seeds of a member of the Vitaceae and on a leguminous pod. According to Miller (1942) this fungus is common in Africa on unspecified seeds and fruits. Culturing of material would probably clarify the host range and geographical range of this species, but our material was not culturable.

Xylaria pallida Berk. & Cooke, J. Linn. Soc. Bot. 15:395. 1876. Fig. 72.

Stromata clavate, conical, or subglobose bearing completely immersed perithecia, with rounded or acute sterile apices, on long narrow, smooth stipes, 1.5-3.5 cm total length X 3-5 mm diam; externally whitish becoming gray to dull black; internally white. Texture very hard. Surface smooth. *Perithecia* 0.5-1.0 mm diam. Ostioles finely discoid, slightly raised. *Asci* not seen. *Ascospores* dark brown, unicellular, ellipsoid-inequilateral with broadly to narrowly rounded ends, smooth, (8.5-)9-10 (-11) X 3.5-4.5 µm, with inconspicuous straight germ slit.

SPECIMEN EXAMINED: San Martín 340, VIII.1987, Ejido Boca de Chajul, Ocosingo municipality, Chiapas state, on wood in evergreen rain forest (ITCV).

NOTES: Our material looks much like that described by Dennis (1956), Pérez-Silva (1975) from México, and Rogers et al. (1988).

Xylaria pallide-ostiolata P. Henn., Engler's Bot. Jahrb. 38:128. 1905. Figs. 73,74,154,155.

Stromata broadly clavate with rounded fertile apices, with long stipes often extended into rooting bases, 10-11 cm total length X 1.5-2 cm diam; externally black with white ostiolar regions, the stipes often with violet-brown tomentum; internally white. Texture cheesy to woody. Surface rugose and further roughened by perithecial contours and ostioles. Perithecia 0.3-0.7 mm diam. Ostioles inconspicuous to hemispherical. Asci eight-spored, cylindrical, poor condition in this material, the spore-bearing part 125-150 μm long X 7-8.5 μm broad, with apical ring bluing in Melzer's iodine reagent, rectangular, 2 μm high X 2.4-3.2 μm broad. Ascospores almost black, unicellular, ellipsoid-inequilateral with abruptly pinched to acute ends, smooth, (12-)14-17(-18) X 6-7 μm, with straight germ slit slightly less than full-length.

SPECIMEN EXAMINED: Guevara 270, II.1986, José María Morelos, Quintana Roo state, on wood (ITCV:JDR).

NOTES: Our material is much like that described and depicted from African material by Lloyd (1918C), except that the ascospores are shorter. A photograph by J. H. Miller (in possession of JDR) shows ascospores as well as stromata. Dennis (1958) put this species into synonymy with X. scruposa (as Xylosphaera). Additional studies are required before the relationship of X. pallide-ostiolata and X. scruposa is clear.

Xylaria persicaria (Schw.: Fr.) Berk. & Curt., Grevillea 4:48. 1867. Figs. 75,76.

Stromata unbranched or branched, cylindrical, bearing crowded or scattered, more or less immersed perithecia, with sterile acute apices, on narrow short to long tomentose stipes, 3.5-7 cm total length X 0.5-2 mm diam; externally blackish with remains of yellowish to brown outer peeling layer; internally white with brown medulla. Texture fairly soft. Surface more or less roughened with perithecial contours. Perithecia 0.3-0.5 mm diam. Ostioles papillate. Asci eight-spored, the spores arranged uniseriately or biseriately, cylindrical, stipitate, 127-162 µm total length X 5.5-7 µm broad, the spore-bearing part 87-100 µm, with apical ring bluing in Melzer's iodine reagent, rectangular, 2-3 µm high X 1-2.5 µm broad. *Ascospores* brown, unicellular, ellipsoid-inequilateral to somewhat navicular with broadly or narrowly rounded ends, smooth, 13.5-16 X (4.5-)5-6(-6.5) µm, with long spiralling germ slit.

SPECIMEN EXAMINED: Chacón-Jiménez 10, X.1987, Ejido Alta Cima, Gómez Farías municipality, Tamaulipas state, on fallen fruits of *Liquidambar styraciflua* L., in cloud forest (ITCV;JDR).

NOTES: This seems like *X. persicaria* as described by Rogers (1979), except that the ascospores are larger than given in that publication. Ascospore size was erroneously cited therein and should have been given as 10-15 X 4-6 on the basis of collections examined. A more recent publication (Rogers, 1986) gives ascospores of this species as 10-15(-16) X 4-6 µm, based upon examination of additional collections.

Xylaria phyllocharis Mont., Ann. Sci. Nat. Bot. (sér. 4) *3:108. 1855.* Figs. 77,78.

Stromata cylindrical bearing fully immersed perithecia, with short acute sterile apices, on long smooth stipes, 0.3-3.8 cm total length X 0.5-1.5 mm diam; externally reddish brown with black ostiolar papillae; internally white. Texture soft. Surface smooth except for ostiolar papillae and peg-like structures that probably represent the remains of the anamorph located immediately below the fertile part. *Perithecia* 0.2-0.3 mm diam. Ostioles strongly papillate. *Asci* eight-spored, the spores arranged in a uniseriate or biseriate manner, cylindrical, stipitate, 103-128 µm total length X 7-10 µm broad, the spore-bearing part 70-83 µm, with apical ring bluing in Melzer's iodine reagent, quadrate to rectangular, 2-4 µm high X 2-3 µm broad. *Ascospores* brown to dark brown, unicellular, ellipsoid-inequilateral with broadly or narrowly rounded ends, smooth, 11-14 X 5-6(-7) µm, with hyaline sheath most evident on immature spores, with straight germ slit slightly less than spore-length.

SPECIMEN EXAMINED: San Martín 338, VIII.1987, Ejido La Unión, Othón P. Blanco municipality, Quintana Roo state, on fallen leaves in median subdeciduous rain forest (ITCV;JDR).

NOTES: This fungus equates well with *X. phyllocharis* as described and illustrated by Dennis (1956). Rogers et al. (1988) described a very similar fungus as *Xylaria* sp. (R1714) from Venezuela. That fungus differed from the present one only in its slightly larger ascospores, larger ascus tip ring, and geniculate surface. The Venezuela fungus is very close to the one described here and probably also represents *X. phyllocharis*.

Xylaria poitei (Lév.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 125. 1851.

Stromata unbranched or branched, clavate to irregular, with rounded fertile apices, on short bases or sessile, 5.5-21.5 cm total length X 2-4 cm diam, externally whitish becoming brownish; internally white, sometimes becoming hollow. Texture hard. Surface smooth under field conditions, becoming rugose on drying; outer layer sloughing on old material. *Perithecia* 0.4-1 mm diam. Ostioles papillate to hemispherical, particularly conspicuous on areas where outer layer has sloughed. *Asci* eight-spored, cylindrical, long-stipitate, 198-229 μm total length X 6-8 μm broad, the spore-bearing part 98-121 μm long, with apical ring bluing in Melzer's iodine reagent, rectangular, 3-3.5 μm high X 2.5-3 μm broad. *Ascospores* dark brown, unicellular, ellipsoid-inequilateral with narrowed ends, smooth, 14-17(-18) X 5.5-6.5 μm, with straight germ slit less than spore-length.

SPECIMENS EXAMINED: San Martín 10, 27.VII.1986, Guadalupe municipality, Nuevo Leon state, on *Carya* wood in oak forest (ITCV,JDR); Castillo 8020, "El Naranjal", Ejido Felipe Angeles, Llera municipality, Tamaulipas state, on wood in a low subdeciduous rain forest (ITCV); *Ventura, F. 2901, 27.XI.1970, Paso de Ovejas, Veracrúz state, on wood (JDR;XAL).

NOTES: Our specimens seem typical for the species (see Rogers, 1984B; Rogers & Callan, 1986B).

Xylaria polymorpha (Pers.: Fr.) Grev., Flora Edin., p. 355. 1824. Fig. 79.

Stromata unbranched or branched, cylindrical to cylindric-clavate to spathulate or grotesque, usually with rounded fertile apices, but occasionally with somewhat acute sterile apices, with short to long stipes sometimes extended as rooting bases, 3-15 cm total length X 0.8-3 cm diam; externally blackish, sometimes with brownish peeling outer layer; internally white to yellowish. Texture hard. Surface rugulose to rugose, often with verrucae and ostiolar papillae. *Perithecia* 0.5-1 mm diam. Ostioles discoid to hemispherical, inconspicuous to pronounced. *Asci* eight-spored, cylindrical, long-stipitate, 197-282 µm total length X 7-11 µm broad, the spore-bearing part 133-182 µm, with apical ring bluing in Melzer's iodine reagent, rectangular to urniform, 5-7 µm high X 4-5 µm broad. *Ascospores* brown to dark brown, unicellular, ellipsoid-inequilateral to navicular with rounded to acute ends, sometimes pinched, smooth, (22-)23-26(-28) X 7.5-8(-9) µm, with straight to oblique germ slit 1/2 to 2/3 spore-length.

SPECIMENS EXAMINED: García 1173, VII.1981, Pisaflores, Hidalgo state, on wood in cloud forest (ITCV); García 2799, VIII.1982, "Rincón de la Sierra", Júarez municipality, Nuevo León state, on wood in *Quercus - Sargentia* forest (ITCV); García 4446, IX.1984, El Cercado, Santiago municipality, Nuevo León state, on wood in low montane *Quercus* spp. forest (ITCV); García 5347, 14.XI.1986, Gómez Farías, Tamaulipas state, on wood in rain forest (ITCV); Guevara 500, II.1986, "Viejo" ranch, José María Morelos municipality, Quintana Roo state, on wood (ITCV,JDR); Guevara 718, no date, Xan Santa Crúz, José María Morelos municipality, on wood (ITCV); San Martin 12, VIII.1986, Gómez Farías, Tamaulipas state, on wood in median subdeciduous rain forest (ITCV); San Martín 394, 1987, Ciudad Victoria, Tamaulipas state, on wood in submontane scrub (ITCV).

NOTES: Typical *X. polymorpha* seems to be most common in the northern parts of the temperate zones. In the tropics it is usually replaced by *X. schweinitzii*, a species from which it is often difficult to separate (Dennis, 1956; Rogers & Callan, 1986A) (see *X. schweinitzii* herein). One collection has subglobose fertile parts and long rooting stipe. Saccardo (1913) called this *X. ophiopoda* Sacc., but we consider it to be a form of *X. polymorpha*. Pérez-Silva (1975) described and illustrated *X. polymorpha* from México, but her concept of this species differs greatly from ours. She gives ascospore dimensions as (15.3-)17 (-18.7) X 6.8(-8.5) µm, close to those of X. scruposa (see elsewhere herein). However, she describes and illustrates ascospores as having a long, straight germ slit, which is unlike either X. polymorpha or X. scruposa in our experience.

Xylaria scabriclavula San Martín & Rogers, sp. nov.
Figs. 80,81,134-136.

Stromata non ramosa vel interdum aliquot exorientia ex eadem basi, clavata cum rotundatis vel leviter acutis extremis, peritheciis immersis praedita, stipitibus brevibus vel longis, 1 cm alta X 1.5-3 mm crassa; extus badia vel nigella cum atris papillis ostiolorum; intus eburnea. Textura mollis. Superficies scaberrima cum profundis fissuris et strato delapso et papillis ostiolorum, stipitibus saepe valde rimosis. Perithecia 0.2-0.3 mm diam. Ostiola manifeste hemisphaerica. Asci saepe biseriate octospori, cylindrici, stipitati, 125-179 µm longitudine tota X 5-8 µm crassi, partibus sporiferis 67-104 µm, annulo apicali in liquore Melzeri cyanescente, aliquantum cuneato, 0.75 µm alto X 1.5 µm crasso. Ascosporae brunneolae vel brunneae, unicellulares, ellipsoideo-inaequilaterales vel allantoideae, leves, 10-12(-14) X 3.5-4.5(-5) µm, rima germinativa inconspicua recta minus quam longituda sporae. Status anamorphosis ignotus.

Stromata unbranched but several sometimes arising from common base, clavate with rounded or somewhat acute apices bearing immersed perithecia, with short or long stipes, 1 cm high X 1.5-3 mm diam; externally reddish brown to blackish with black ostiolar papillae; internally cream-colored. Texture soft. Surface very rough with deep cracks and sloughing layer and ostiolar papillae, the stipes often especially cracked. Perithecia 0.2-0.3 mm diam. Ostioles hemispherical, prominent. Asci eight-spored, the spores arranged in a uniseriate or partly biseriate manner, cylindrical, stipitate, 125-179 µm total length X 5-8 µm broad, the spore-bearing part 67-104 µm, with apical ring bluing in Melzer's iodine reagent, somewhat wedge-shaped, 0.75 µm high X 1.5 µm broad. Ascospores light brown to brown, unicellular, ellipsoid-inequilateral to allantoid, smooth, 10-12(-14) X 3.5-4.5 (-5) µm, with inconspicuous straight germ slit less than full-length.

SPECIMENS EXAMINED: San Martín 77, 8.XII.1986, Ejido La Unión, Othón P. Blanco municipality, Quintana Roo state, on *Thrinax radiata* Lodd. ex J. A. & J. H. Schult. wood in *median subdeciduous* rain forest (ITCV;JDR); San Martín 341, VIII.1987, (same data as no. 77 above) (HOLOTYPE: ITCV; ISOTYPE:JDR).

NOTES: This curious fungus has been collected twice at the same general location on monocot wood. It is noteworthy for its regular clavate stromata that are highly roughened when examined with a lens. It might be host-specific.

Xylaria schweinitzii Berk. & Curt., *J. Acad. Nat. Sci. Phil. (ser. 2)* 2:284. 1853. Figs. 82,83.

X. *obovata* (Berk.) Fr., Nova Acta Regiae Soc. Sci. *Upsal. (ser.* 3) 1, p. 127. 1851; fide Laessøe in litt.

Stromata subglobose to cylindrical-irregular, with *rounded fertile* apices, on abrupt short stipes or nearly sessile, 1.5-2.5 cm total length X 0.5-1.6 cm diam; externally dark brown to blackish; internally white to yellowish. Surface somewhat roughened by wrinkles, verrucae, and ostiolar papillae. *Perithecia* 0.3-0.9 mm diam. Ostioles discoid to hemispherical. *Asci* eight-spored, cylindrical, stipitate, 210-229 μm total length X 7-9 μm broad, the spore-bearing part 140-145 μm long, with apical ring bluing in Melzer's iodine reagent, rectangular, 5.5-7(-7.5) μm high X 3.5-5.5(-6) μm broad. *Ascospores* brown to dark brown, unicellular, ellipsoid-inequilateral to navicular with rounded to acute ends, smooth, 21-26 X (6-)6.5-8 μm, with oblique germ slits less than spore-length.

SPECIMEN EXAMINED: García 3059, 31.X.1982, Los Tuxtlas Experiment Station, Balzapote, Veracrúz state, on wood in evergreen rain forest (ITCV;JDR).

NOTES: Our concept of *X. schweinitzii* is the traditional one set forth by Dennis (1956), Carroll (1964), Pérez-Silva (1975), Rogers & Callan (1986A), Lloyd (1919, 1920), Miller (1934), and others. In our view *X. schweinitzii* is a tropical variant of *X. polymorpha* that usually exhibits a smoother surface and has ascospore germ slits that are less than spore-length and oriented oblique to the long axis of the spore. Our concept of *X. obovata*

(Berk.) Fr. is as a member of the *X. polymorpha* complex with a much smoother (often unwrinkled) surface (Rogers et al., 1988).

Xylaria scruposa (Fr.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 127. 1851; sensu Dennis, Kew Bull. 1956:436. 1956. Figs. 84,87.

Stromata unbranched or branched, cylindrical, clavate, or irregular, with rounded fertile apices or somewhat acute sterile apices, on short to long stipes, 1.5-6 cm total length X 2-6 mm diam; externally dark brown to black, sometimes with brown scales; internally white to yellowish. Texture woody. Surface rugose, sometimes additionally roughened with tomentum or ostiolar papillae. *Perithecia* 0.5-1 mm diam. Ostioles inconspicuous to hemispherical. *Asci* eight-spored, cylindrical, stipitate, 188-224 μm total length X 7.5-8 μm broad, the spore-bearing part 100-146 μm, with apical ring bluing in Melzer's iodine reagent, rectangular, 5-6 μm high X 3.5-5 μm broad. *Ascospores* brown to dark brown, unicellular, ellipsoid-inequilateral to navicular with rounded to acute ends, smooth, 18-21(-22) X 6-7 μm, with oblique to spiralling germ slit less than spore-length.

SPECIMENS EXAMINED: *Brown, D. 14, 28.IX.1981, Parque Fco. Javier Clavijero near Xalapa-Coatepec, on wood (JDR;XAL); *Magaña 19, Michoacán, (JDR;XAL); San Martín 251, VIII.1987; "El Muneco", Ejido Loma Bonita, Ocosingo municipality, Chiapas state, on wood in evergreen rain forest (ITCV;JDR); San Martín 252, 365, 369, 373, VIII.1987, Ejido Boca de Chajul, Ocosingo municipality, Chiapas state, on wood in evergreen rain forest (ITCV; 252 and 369 also in JDR).

NOTES: *Xylaria scruposa* is a complex taxon, a small-spored member of the *X. polymorpha* complex. Its limits are unclear (see Rogers *et al.*, 1988 and refs. therein for discussions of this taxon).

Xylaria sp. (SM 38,64) Figs. 91,93.

Stromata unbranched to branched, cylindrical to cylindric-clavate with acute to obtuse, sterile or fertile apices, on short to long tomentose stipes that arise from pannose bases, 1-5 cm total length X 1-3 mm diam; externally blackish with brown peeling outer layer; internally white. Texture soft. Surface rugose and roughened with ostiolar papillae. Perithecia 0.2-0.3 mm diam. Ostioles papillate, conspicuous and crowded. Asci eight-spored, cylindrical, long-stipitate, 90-125 µm total length X 5-6 µm broad, the spore-bearing part 60-65 µm, with apical ring bluing in Melzer's iodine reagent, somewhat discoid, 0.75 µm high X 1.5 µm broad. Ascospores brown to dark brown, ellipsoid-inequilateral with one end sometimes bearing a tiny cellular appendage, smooth, 8-9(-10) X 4.5-5 µm, with straight germ slit spore-length.

SPECIMENS EXAMINED: *Basilio, M. 53, 20.XI.1979, El Teposteco, Morelos, on wood (JDR;XAL); San Martín 38, 10.IX.1987, Gómez Farías, Tamaulipas state, on wood in median subdeciduous rain forest (ITCV;JDR); San Martín 64, 7.XII.1986, San Felipe Bacalar, Othón P. Blanco municipality, Quintana Roo state, on wood in acahual (ITCV;JDR).

NOTES: This is another dark, small-spored Xylaria that does not fit into any species known by us. It possibly is X. aemulans Starback as understood by Lloyd (1921). We have not seen type material of that species.

Xylaria sp. (SM 39, 306) Figs. 90,92.

Stromata unbranched or branched, cylindrical, bearing completely immersed perithecia, with attenuated or acute sterile apices, on short stipes often arising from pannose bases, 1-2.5 cm total length X 2-4 mm diam; externally blackish with reddish brown to dark brown peeling outer layer; internally dirty white. Texture hard. Surface smooth. Perithecia 0.5-1 mm diam. Ostioles barely raised, located in flattened circular areas ca. 0.2 mm diam. Asci eight-spored, cylindrical, very long stipitate, 140-200 µm total length X 5-6 µm broad, the spore-bearing part 70-80 µm, with apical ring bluing in Melzer's iodine reagent, quadrate, 2 X 2 µm. Ascospores brown, unicellular, ellipsoid-inequilateral with broadly or narrowly rounded ends, smooth, (9-) 9.5-11(-12) X 4(-4.5) µm, with straight germ slit spore-length.

SPECIMENS EXAMINED: San Martín 39, 8.XII.1986, Ejido La Unión, Othón P. Blanco municipality, Quintana Roo state, on wood in median subdeciduous rain forest (ITCV;JDR); San Martin 306, VIII.1987 (same data as no. 39) on soil (ITCV).

NOTES: This fungus might only be a variant of X. multiplex, differing from more typical material in having ostioles often surrounded by a disc and in lacking any perithecial contours. In surface features it resembles X. adscendens.

Xylaria sp. (SM 211) Fig. 94.

Stromata composed of cylindrical to conical aggregations of more or less naked perithecia, with acute sterile apices, on filiform glabrous stipes, 5-13 mm total length X 0.5-1.5 mm diam; externally black; internally white. Texture fairly hard. Surface smooth except for perithecial elevations. Perithecia 0.2-0.3 mm diam. Ostioles papillate. Asci eight-spored, cylindrical, stipitate, 73-83 total length X 4-5 µm broad, the spore-bearing part 47-50 µm, with apical ring bluing in Melzer's iodine reagent, quadrate, 1-1.3 X 1-1.3 µm. Ascospores light brown to brown, unicellular, ellipsoid-inequilaterial with broadly or narrowly rounded ends, smooth, (5.5-)6-7 X 3-3.5(-4) µm, with straight germ slit slightly less than spore-length.

SPECIMEN EXAMINED: San Martín 211, 16.VII.1987, Gómez Farías, Tamaulipas state, on fallen leaves in median subdeciduous rain forest (ITCV).

NOTES: This tiny Xylaria might well represent a new species. Our collection is so small, however, that we decline to describe it as new.

Xylaria sp. (SM 303) Figs. 95,96.

Stromata solitary or many originating from common base, cylindric-clavate to irregular with subacute to narrowly rounded sterile apices, on short stipes, 1.3-4 cm total length X 3-6 mm diam; externally black, sometimes with brown tones; internally white to yellowish. Texture cheesy. Surface so deeply cracked as to appear verrucose, with tomentum on stipe and in patches on fertile part. Perithecia 0.3-0.5 mm diam. Ostioles hemispherical, often flattened, difficult to distinguish from verrucae. Asci cylindrical, stipitate, 148-166 µm total length X 5.5-7 µm broad, the spore-bearing part 80-90 µm, with apical ring bluing in Melzer's iodine reagent, rectangular, 3-4.5 µm high X 2-3 µm broad. Ascospores brown to dark brown, unicellular, ellipsoid-inequilateral with narrow ends, smooth, (12-)12.5-14.5(-16) X 5-5.5(-6) µm, with straight germ slit less than spore-length.

SPECIMEN EXAMINED: San Martín 303, 31.VIII.1987, Ejido La Unión, Othón P. Blanco municipality, Quintana Roo state, on wood of Thrinax radiata Lodd. ex J. A. & J. H. Schult. in median subdeciduous rain forest (ITCV).

NOTES: This fungus is probably another small-spored member of the X. polymorpha complex. It seems allied to X. feejeensis and X. luteostromata Lloyd. Most of our material is immature and even material showing fully colored ascospores is probably not entirely mature. We thus refrain from describing it as a new taxon, although it might well be such.

Xylaria sp. (SM 331) Figs. 99,100.

Stromata unbranched or branched, cylindrical to irregular with acute sterile apices, on abrupt thin short to long stipes, 1.5-3.5 cm total length X 2-3 mm diam; externally black without trace of peeling layer; internally yellowish. Texture soft to woody. Surface smooth except for perithecial undulations. Perithecia 0.5-0.8 mm diam. Ostioles conical, inconspicuous. Asci not seen. Ascospores brown, unicellular, ellipsoid-inequilateral with rounded ends, smooth, 9-10.5(-11) X 4-5 µm, with straight germ slit less than spore-length.

SPECIMEN EXAMINED: San Martín 331, VIII.1987, Ejido Boca de Chajul, Ocosingo municipality, Chiapas state, on wood in evergreen rain forest (ITCV;JDR).

NOTES: We do not know this fungus. Our material is overmature and asci are altogether lacking.

Xylaria sp. (SM 337) Figs. 15,16,114.

Stromata consisting of head of immersed perithecia 1.5 mm diam on tomentose hair-like rachis that extends downward as a stipe and upward as a long apex, up to 2.3 cm long; externally blackish with white flaking outer layer; internally white. Texture soft. Surface smooth except for ostiolar papillae. Perithecia 0.2-0.3 mm diam. Ostioles papillate to almost digitate. Asci eight-spored, the spores arranged in a uniseriate to partly biseriate manner, cylindrical, long-stipitate, 117-154 µm total length X 6-10 µm broad, the spore-bearing part 67-76 µm, with apical ring bluing in Melzer's iodine reagent, quadrate to rectangular, 3-4 µm high X 2-3 µm broad. Ascospores brown to dark brown, ellipsoid-inequilateral with one end bearing a cellular hyaline appendage ca. 2 µm X 2 µm, smooth, 10-12(-14) X 5-6 µm, with straight germ slit spore-length.

SPECIMEN EXAMINED: San Martín 337, VIII.1987, San Felipe Bacalar, Othón P. Blanco municipality, Quintana Roo state, on fallen leaves (ITCV).

NOTES: The present fungus greatly resembles X. sicula Pass. and Beltr. f. major Ciccarone in the hair-like rachis with the intercalary fertile portion and size of ascospores (Ciccarone, 1946). It differs in having immersed perithecia, a tomentose rachis, and ascospores with a cellular appendage. This latter feature is easily missed unless critical microscopy is employed. It greatly resembles X. aristata sensu Dennis (1956) in the morphology of the fertile part and in the hairy stipe, but differs from his description in having a portion of the rachis extending beyond the fertile head and in having appendaged ascospores. It resembles X. aristata described herein, but differs in larger appendaged ascospores, in larger asci and in having a portion of the rachis extending beyond the fertile part. Dargan (1976) illustrated X. aristata as having a short mucro on the fertile portion. He described perithecia as being completely immersed, but illustrated them as being fairly conspicuous, i.e., as surface contours. Miller (1942) described X. aristata as having glabrous stipes and protruding perithecia. Our fungus also greatly resembles Dargan's Xylaria sp.-III in ascospore size and in the long portion of rachis projecting beyond the fertile head (Dargan, 1976). In any case, it is probably most prudent to allow our present small collection to remain unnamed until additional studies of similar fungi are undertaken.

Xylaria sp. (SM 359) Figs. 97,98.

Stromata cylindrical with fertile apices, on short pubescent stipes, prostrate in our material, 7-10 mm total length X 1-3 mm diam; externally blackish with brown outer peeling layer, with ostioles often white-fringed; internally white. Texture soft. Surface with circumferentially-oriented wrinkles and roughened with ostiolar papillae. *Perithecia* 0.4-0.7 mm diam. Ostioles strongly conical. *Asci* eight-spored, the spores arranged in a uniseriate to biseriate manner, cylindrical, stipitate, 132-148 µm total length X 5.5-7 µm broad, the spore-bearing part 82-88 µm, with apical ring bluing in Melzer's iodine reagent, quadrate, 2 X 2 µm. *Ascospores* brown, unicellular, ellipsoid- inequilateral, with broadly to narrowly rounded ends, smooth, (11-)13-14 (-15) X 4-5 µm, with germ slit obscure.

SPECIMEN EXAMINED: San Martín 359, VIII.1987, Ejido Boca de Chajul, Ocosingo municipality, Chiapas state, on wood in evergreen rain forest (ITCV;JDR).

NOTES: Our fungus highly resembles Lloyd's photograph (1921) of *X. biformis* Lloyd, but his description is of a fungus with much larger ascospores. Laessøe (in litt.) considers *X. biformis* to be a synonym of *X. globosa* (= *X. anisopleura*). Our fungus also resembles a diminutive *X. berkeleyi*. In any case, we do not assign it to a known taxon herein.

Xylaria sp. (SM 372) Figs. 101,102.

Stromata cylindrical to cylindric-clavate with rounded fertile apex, on abruptly narrowed long stipe, 1.5-2 cm total length X 1-2 mm diam; externally blackish with persistent brown outer sloughing layer; internally white. Texture hard, but fragile. Surface roughened by sloughing layer and perithecial undulations. *Perithecia* 0.2-0.6 mm diam. Ostioles papillate. *Asci* eight-spored, cylindrical, poor condition in this material, the spore-bearing part ca. 50-60 µm long X 5-6 µm broad, with apical ring bluing in Melzer's iodine reagent, quadrate, 2 X 2 µm. *Ascospores* brown to dark brown, unicellular, ellipsoid-inequilateral with rounded ends, smooth, 9-10 (-11) X (4-)4.5-5 µm, without obvious germ slit.

SPECIMEN EXAMINED: San Martín 372, VIII.1987, Ejido Boca de Chajul, Ocosingo municipality, Chiapas state, on wood in evergreen rain forest (ITCV).

NOTES: This fungus is not known to us and probably represents a new species. Perithecia of our material, however, were not in good condition and asci could not be fully characterized.

Xylaria sp. (G729) Figs. 85,86.

Stromata cylindrical with acute sterile apex, without differentiated stipe, the base tomentose, 1.5-3 cm total length X 1.5-3 mm diam; externally blackish with brownish outer peeling layer; internally whitish. Texture hard. Surface smooth except for ostiolar papillae and remains of tomentum. *Perithecia* 0.3-0.4 mm diam. Ostioles conical to hemispherical, conspicuous. *Asci* eight-spored, cylindrical, long-stipitate, 123-144 µm total length X 4-6 µm broad, the spore-bearing part 63-70 µm, with apical ring bluing in Melzer's iodine reagent, quadrate to rectangular, 1.5-2.5 µm high X 2 µm broad. *Ascospores* light brown, unicellular, ellipsoid-inequilateral with rounded ends, smooth, (8.5-)9-11 X (3-)3.5-4(-4.5) µm, with straight germ slit less than spore-length.

SPECIMEN EXAMINED: Guevara 729, 1986, Xan Santa Crúz, Jose María Morelos municipality, Quintana Roo state, on wood in an acahual (ITCV;JDR).

NOTES: This small *Xylaria* is unknown to us. In general morphology it resembles *X. myosurus* in lacking a real stipe, but the tomentose base is unlike that species.

Xylaria squamulosa San Martín & Rogers, sp. nov.
Figs. 103,104,111,112.

Stromata subglobosa vel elongata, 5 mm diam vel 6 mm longa X 4 mm crassa, peritheciis omnino immersis, in abrupte angustatis stipitibus 1-1.5 cm longis X 1-1.5 mm diam; extus fumea sed sub lente nigella cum elevatis albidis squamis; intus alba. Textura dura. Superficies levis praeter fissuras inter squamas. Perithecia ca. 1 mm diam. Ostiola plus minusve umbilicata, inconspicua. Asci saepe biseriate ostospori, cylindrici, longe stipitati, 370-430 longitudine tota X 14-27 µm crassi, partibus sporiferis 182-252 µm, annulo apicali in liquore Melzeri cyanescente, urceolato vel obtrullato, 11-13 alto X 6-7 µm crasso. Ascosporae brunneae, unicellulares, ellipsoideo-inequilaterales vel plus minusve rectangulatae cum late rotundatis extremis vel abrupte acutis extremis, leves, (29-)31-37(-40) X (11-)12-13(-14) µm, saepe ab hyalina vagina indutae, rima germinativa recta per longitudinem sporae. Anamorphosis ignotus.

Stromata subglobose to elongated, 5 mm diam to 6 mm long X 4 mm diam, with completely immersed perithecia, on abruptly narrowed stipes 1-1.5 cm long X 1-1.5 mm diam; externally blackish gray, but with lens seen to be blackish with raised whitish scales; internally white. Texture hard. Surface smooth except for cracks between scales. Perithecia ca. 1 mm diam. Ostioles more or less umbilicate, inconspicuous. Asci eight-spored, the spores oriented in a uniseriate or partially biseriate manner, long-stipitate, 370-430 µm total length X 14-27 µm broad, the spore-bearing part 182-252 µm, with apical ring bluing in Melzer's iodine reagent, urn-shaped or coffin-shaped, 11-13 µm high X 6-7 µm broad. Ascospores dark brown, unicellular, ellipsoid-inequilateral to more or less rectangular with broadly rounded or abruptly acute ends, smooth, (29-)31-37(-40) X (11-)12-13(-14) µm, often with hyaline sheath, with straight germ slit spore-length. Anamorph unknown

SPECIMEN EXAMINED: San Martín 63, 8.XII.1986, Ejido La Union, Othon P. Blanco municipality, Quintana Roo state, on wood in median subdeciduous forest (HOLOTYPE:ITCV).

NOTES: This fungus appears to be an undescribed species. It is probably the same as Xylaria sp. (S 1836) described by Rogers et al., 1988). The fertile part of that fungus lacked the pronounced scaliness of the one described here, but shows conspicuous papillate ostioles. In other characteristics these fungi seem very similar.

Xylaria telfairii (Berk.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 127. 1851.

Stromata clavate-fusiform with rounded fertile apices, on short to long stipes, up to 6.5 cm total length X 4-9 mm diam; externally tan or yellowish to dull orange, often black from spores; internally white, but becoming hollow and inrolled, often before maturation of perithecia. Texture hard, but fragile. Surface smooth. Perithecia 0.4-0.7 mm diam. Ostioles umbilicate. Asci not observed. Ascospores light brown to brown, unicellular, ellipsoid-inequilateral with narrowed ends, smooth, (17-)18-21(-22) X (5.5-)6-7 µm, with short, oblique germ slit.

SPECIMENS EXAMINED: San Martín 220, VIII.1987; 352, VIII. 1987, Ejido Boca de Chajul, Ocosingo municipality, Chiapas state, on wood in evergreen rain forest (ITCV,JDR).

NOTES: Our material seems typical for the species. It has been described and illustrated from Mexican material by Pérez-Silva (1975). See remarks by Dennis (1956) and Rogers et al. (1988).

Xylaria uniapiculata San Martín and Rogers, sp. nov.
Figs. 105-107,124-126.

Stromata plerumque maxime ramosa e basi vel super basim, plus minusve cylindracea vel teretia vel complanata, plerumque apicibus acutis sterilibus, in stipitibus brevibus e basibus pannosis, 2.5-5.5 cm longa X 2-6 mm crassa; extus rufa vel brunnea vel nigella cum strato externo fusco delapso; intus alba vel flavida. Textura lignosa. Superficies valde asperata ab verrucis prominentibus, fissuris, papillis ostiolorum, et formis peritheciorum. Perithecia 0.4-0.8 mm diam. Ostiola papillata. Asci octospori, cylindrici, stipitati, 115-138 longitudine tota X 5-6 µm crassi, partibus sporiferis 70-90 µm, annulo apicali in liquore Melzeri cyanescente, quadrato vel oblongo, 2.5-3 µm alto X 1.5-2 µm crasso. Ascosporae brunneae, plerumque in uno extremo cellula minuta hyalina ornati, ellipsoidea-inequilaterales, leves, 9-10(-11) X (3.5-)4 µm, rima germinativa recta per longitudinem partis coloris sporae. Anamorphosis ignotus.

Stromata usually highly branched from base or above, more or less cylindrical, terete or flattened, usually with somewhat acute sterile apices, on short stipes from pannose bases, 2.5-5.5 cm high X 2-6 mm diam; externally reddish brown, dark brown to black with peeling outer brown layer; internally white to yellowish. Texture woody. Surface strongly roughened with prominent verrucae, cracks, ostiolar papillae, and perithecial contours. Perithecia 0.4-0.8 mm diam. Ostioles papillate. Asci eight-spored, cylindrical, stipitate, 115-138 µm total length X 5-6 µm broad, the spore-bearing part 70-90 µm, with apical ring bluing in Melzer's iodine reagent, quadrate to rectangular, 2.5-3 µm high X 1.5-2 µm broad. Ascospores brown, usually with a minute hyaline cell on one end, ellipsoid-inequilateral, smooth, 9-10(-11) X (3.5-)4 µm, with straight germ slit running the full length of the pigmented cell of the spore.

SPECIMENS EXAMINED: Chacón 191, X.1987, Gómez Farías, Tamaulipas state, on wood in median subdeciduous rain forest (HOLOTYPE:ITCV; ISOTYPE:JDR); Rodríguez 31 and Santos López 4, same data as above (ITCV;JDR).

NOTES: This species is probably related to *X. feejeensis* and *X. rhytidophloea* Mont. According to Dennis (1956) the latter name is a synonym of the former. Lloyd (1924A) gives the ascospores as 18 X 8 µm, much larger than those of *X. feejeensis* or the present fungus. The main feature leading us to consider this a new species is the persistent cellular ascospore appendage.

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VARICOSPORIUM SCOPARIUM, A NEW STAUROSPOROUS HYPHOMYCETE

by

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Summary: Varicosporium scoparium sp. nov. is described in pure culture from foam samples in Spanish streams.

Conidia of the new species described below were illustrated by ROLDAN et al. (1988) from foam samples in the River Mundo (Albacete Spain). They have also been detected in several of its tributaries and in the River Vinalopó (Alicante, Spain). Its substrate remains unknown. Conidia only appear ater rains, and thus we believe it should be considered waterborne rather than strictly aquatic.

Varicosporium scoparium sp. nov. (Figs. 1-3)

Hyphomycetes Moniliaceae. COLONIAE (1% MA) pallide cremosae, patentes ad 4.5 cm diam/5 septimanis, glabrae, mycelio aerio absente, hyphae 1.5–2 µm latae. SPORULATIO copiosa post 5 diebus (14–18°), summa aqua vel submersa. CONIDIOPHORA mononematosa, apicalia vel lateralia, semimacronematosa, simplicia vel bracchiata, usque ad 300 x 2–3 µm. CELLULAE CONIDIOGENAE apicales (vel intercalares vel laterales), 8–16 x 2–3 µm, monoblasticae vel polyblasticae, proliferationes sympodiales; cicatrices denticulatae. CONIDIA solitaria vel laxe fasciculata, acrogena, typice in planibus variis, elementi cylindrici; axis principalis leve curvatus vel sigmoideus, 80–150 (raro ad 350) x 2–3.5 µm, usque ad 6-septatus, cicatrix truncata; bracchia in 1–3 dispositionibus, lateralia, singularia, principale unilateralia recta vel tenue curvata 0–3 septata, insertio typice sinuosa et inaequaliter constricta. Disjunctio conidiorum schizolytica. Germinatio in aqua et in agaro cum antibioticis.

COLONY (1% MA) pale cream-coloured, reaching 4–5 cm diam/5 weeks at 14–18°, glabrous, aerial mycelium wanting, hyphae 1.5–2 µm wide. SPORULATION on slices of culture partly submerged in sterile, distilled standing water for 5 days at room temperature (14–18°), at or below water level, producing numerous highly branched conidia. CONIDIOPHORES mononematous, apical or lateral, semimacronematous, simple or branched, up to 300 x 2–3 µm. CONIDIOGENOUS CELLS apical (or intercalary or lateral), 8–16 x 2–3 µm, mono- or polyblastic, proliferating sympodially; secession scars denticulate. CONIDIA solitary or loosely fasciculate, acrogenous, typically branched in more than one plane, elements cylindrical, apices rounded; main axis slightly curved (or somewhat sinuate), sometimes with loss of apical dominance, 80–150 (rarely up to 350) x 2–3.5 µm,

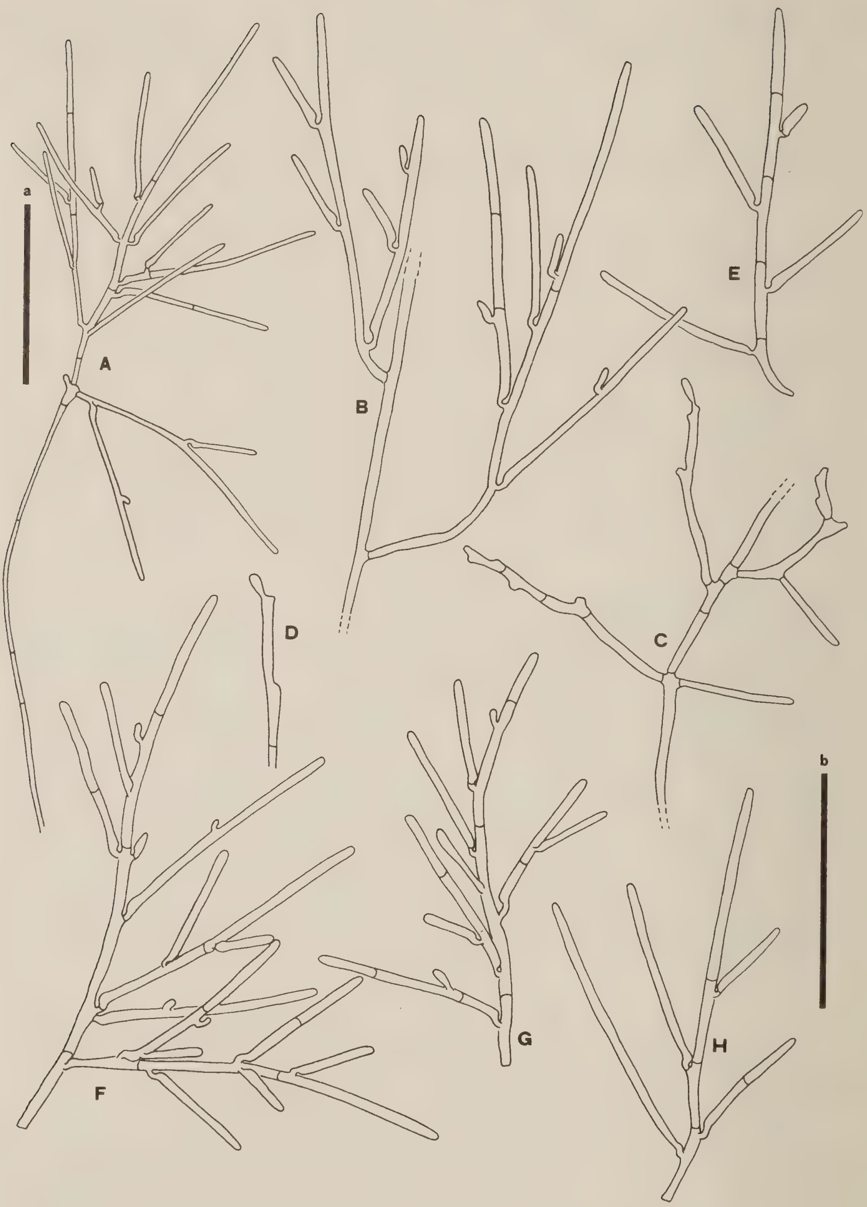

Fig. 1.- Varicosporium scoparium in pure culture. A-D: conidiophores. E-H: conidia. (from holotype). A: scale a = 50 µm. B-H: scale b = 40 µm.

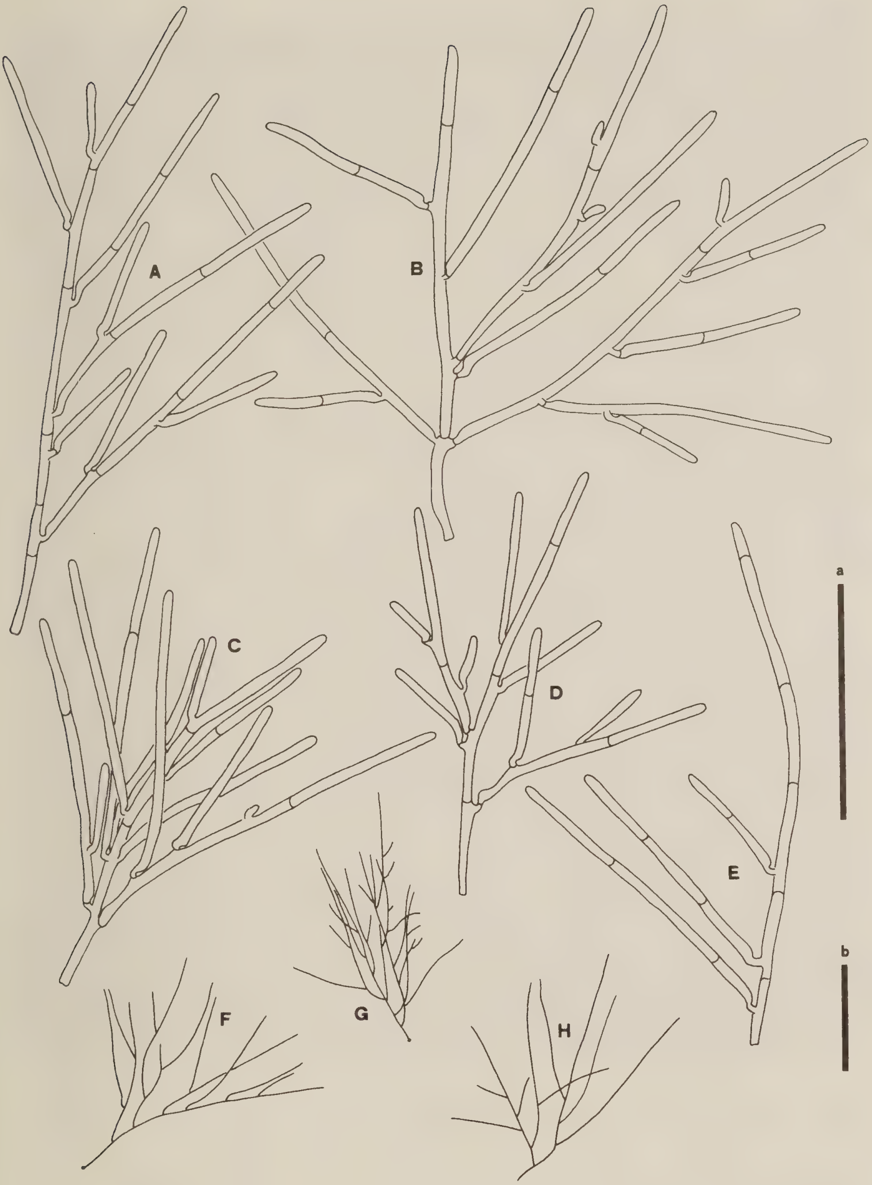
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Fig. 2.- Varicosporium scoparium. Detached conidia. A–E: scale a = 40 µm. F–H (unusual larger conidia): scale b = 100 µm.

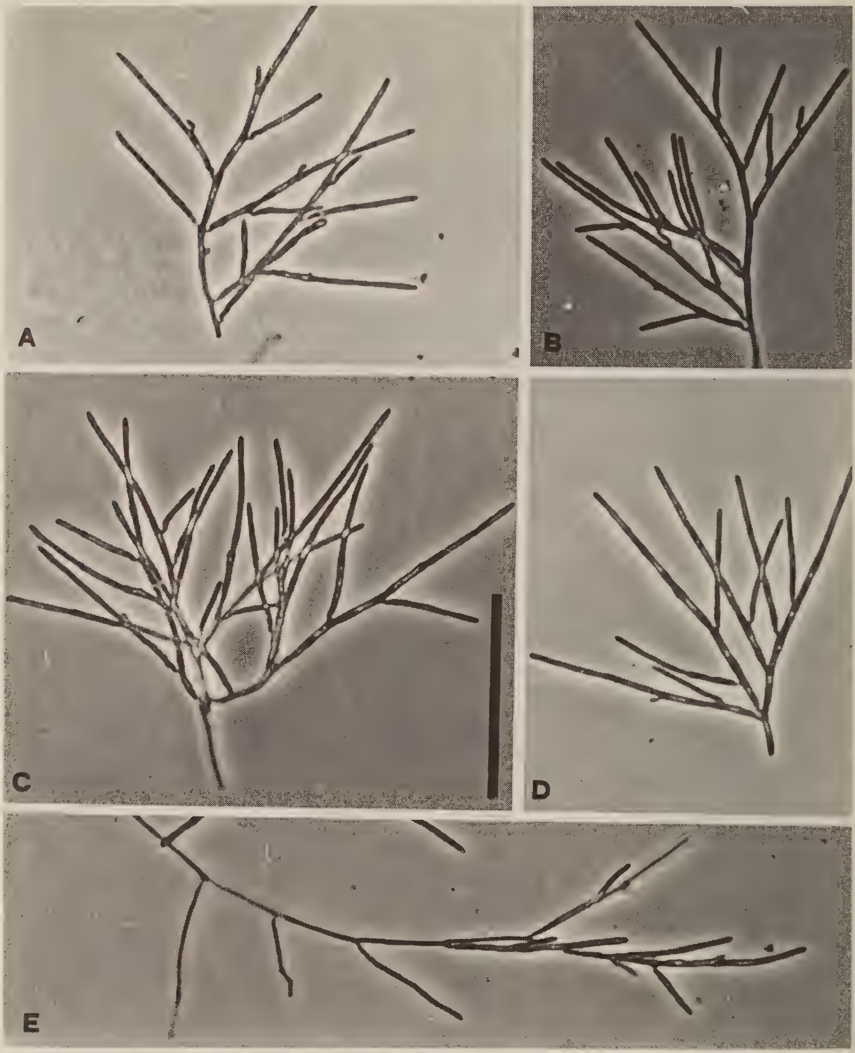

Fig. 3.- Varicosporium scoparium. E: conidiophore. All to same scale, bar = 50 μm.

up to 6-septate, scar truncate; branches in 1-3 orders, lateral, single, diverging in various planes and mostly on one side of the parent element, straight or slightly curved, characteristically sinuous and asymetrically constricted at the insertion, 0-3 septate. Conidia germinate readily in liquefied foam or on isolation media supplemented with streptomycin and penicillin (Descals *et al.* 1977).

COLLECTIONS: single conidia isolate from foam in River Mundo, Albacete (UTM WH 9457) (Roldán, Nov. 1987) (MA-fungi 20841 holotype ex MUB AR9851 isotype); other isolates from locus typici MUB AR 9852, MUB AR9853; stream foam from River Mundo, Albacete (Roldán, Nov. 1985, A-25); stream foam from River Vinalopó, Alicante (UTM YH 0282) (Roldán, Nov. 1985, A-77).

There are various staurosporous genera of aquatic hyphomycetes with conidia branching in more than one order and plane, such as *Dendrospora* Ingold, *Polycladium* Ingold and *Varicosporium* Kegel. In *Dendrospora* conidia are apical and solitary with conidiogenous cells sometimes proliferating percurrently (DESCALS & WEBSTER, 1980). Furthermore, *D. erecta* Ingold (type species) displays verticillate branching, not seen in our species, although this character is less evident in *D. polymorpha* Roldán & Descals (ROLDAN *et al.*, 1987). Conidial insertion in *Polycladium equiseti* Ingold (1959) (type and only species) is clearly lateral. *Varicosorium scoparium* appears to be closely related to *V. elodeae* Kegel (INGOLD, 1942) (type species) but here conidia bear broadly divergent branches and secede by abstriction at a narrowed insertion. Conidia of *V. delicatum* (Iqbal, 1971) are typically larger than in *V. scoparium* and are produced singly and terminally. *Cladoconidium articulatum* Bandoni & Tubaki (1985) has repeatedly branched pale fuscous conidia, with somewhat sinuous constricted branched insertion. However, this species has olivaceous colonies and the conidia are mostly spanning 30-42, rarely up to 60 µm.

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A NEW ADDITION TO THE GENUS GORGOMYCES

by

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Summary: Gorgomyces honrubiae sp. nov. is described in pure culture from foam samples in Spanish streams. Characters related with conidiogenesis in this genus are discussed.

Gorgomyces honrubiae sp. nov. (Figs. 1-3)

Hyphomycetes Moniliaceae. **Coloniae** (1% MA), albidae, patentes ad 3 cm diam/5 septimani, glabrae, mycelio aerio absente; hyphae saepe cincinnatae, 1-2 μm latae. **Sporulatio** submersa et sparsa. **Conidiophora** semimacronematosa, mononematosa, typice lateralia, cum stipite et capite conidiogeno, stipes irregulariter clavatus et curvatus, 5-8 x 2-3.5 μm, typice 0-septatus; caput conidiogenum est racemus condensus, eodem tempore fructificans. **Cellulae conidiogenae** inflatae, 3-6 x 1.5-2.5 μm, monoblasticae, determinatae, collabentes. **Conidia** solitaria, apicalia (vel lateralia), filiformia; cum cellula basali et appendice apicale; corpus conidialis parce subulatus, paene rectus vel spiralis vel sigmoideus, 35-45 x ca. 2 μm, 8-9 septatus; appendix apicalis ad basim constricta et septata, 9-16 μm longa, unicelularis, collabens ante secessionem conidii; cellula basalis ca. 2 x 1.5 μm, cum mucrone laterale breve, postea collabens et mucosa. Conidia in aqua singillatim vel aggregatim dispersa, ad basim adherentia. Germinatio e pluribus cellulis.

Etym: named in acknowledgement to Dr. M. Honrubia (University of Murcia, Spain).

Hyphomycetes, Moniliaceae. **Colonies** (1% MA) whitish, spreading slowly, reaching 3 cm diam/5 weeks, glabrous, aerial mycelium absent; hyphae strongly coiled, 1-2 μm wide. **Sporulation** underwater, sparse. **Conidiophores** semimacronematous, mononematous, typically lateral, with a stipe and an irregularly branched conidiogenous head, total length 12-22 μm; stipe irregularly clavate and curved, 5-8 x 2-3.5 μm, typically 0-septate; **Conidiogenous** cells variously swollen, 3-6 x 1.5-2.5 μm, monoblastic, determinated, evacuated after conidial secession. **Conidia** solitary, apical (or lateral), consisting (initially) of a filiform body, an apical walled appendage and a stalk cell. Conidial body slightly subulate, almost straight to helical (1-1.5 coils) or sigmoid, 35-45 x ca. 2 μm, septa initially distant, later 8-9 by secondary septation; apical appendage constricted at basal septum, 9-16 um long, unicellular, becoming evacuated and collapsing prior to secession; stalk cell ca. 2

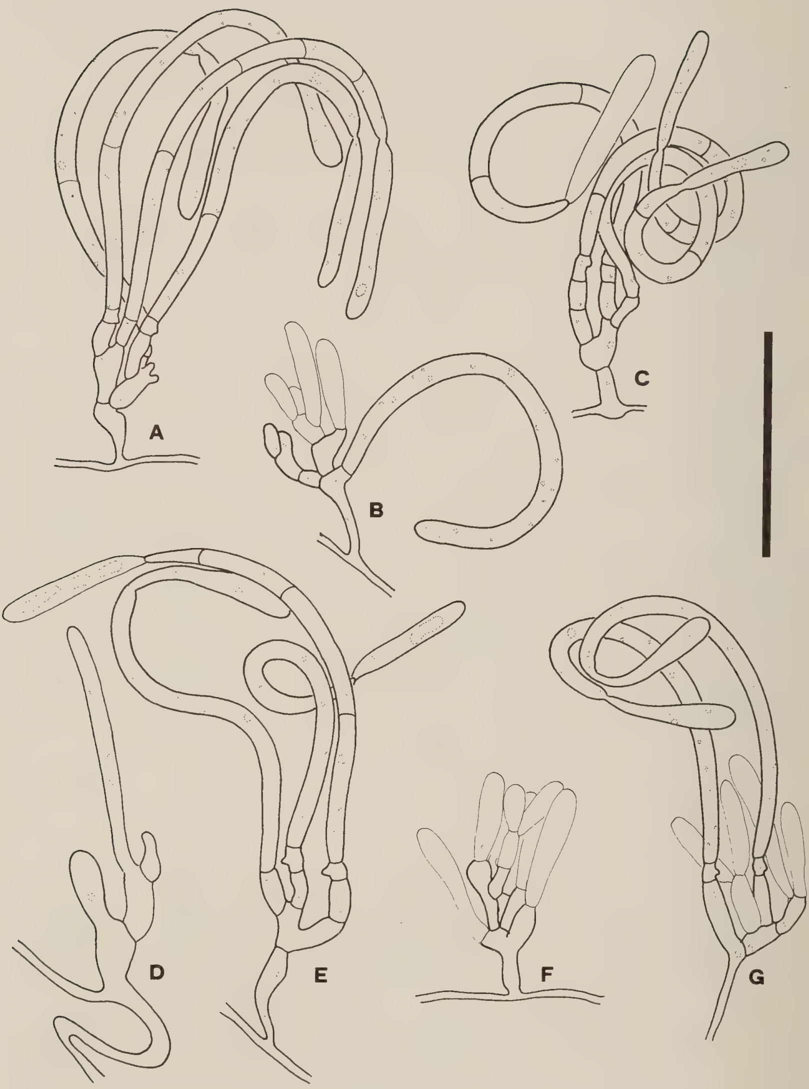

Fig. 1.- Gorgomyces honrubiae in pure culture (from holotype). A-G: conidiophores and developping conidia. Notice collapsed conidiogenous cells after conidial secession in B, F and G. Bar: 20 µm.

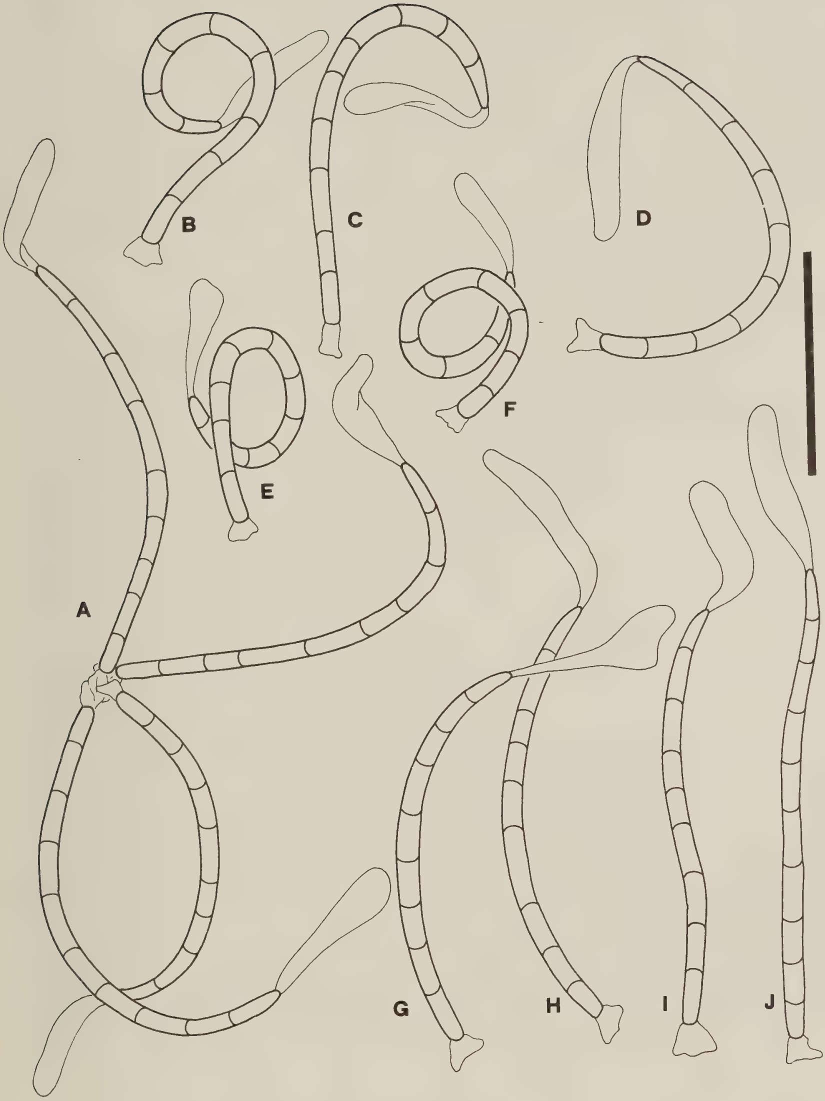

Fig. 2.- Gorgomyces honrubiae in pure culture (from holotype). A: conidial group adhering to each other at their mucous base. B-J: single detached conidia. Bar: 20 µm.

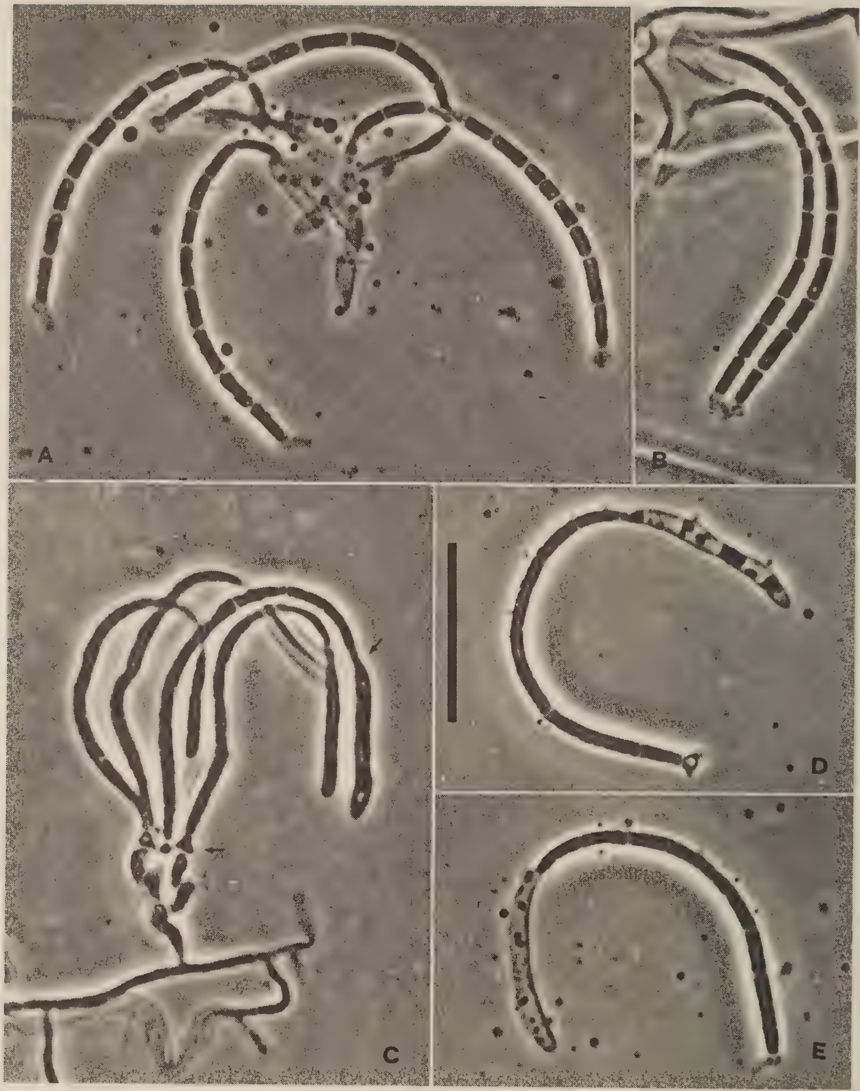

Fig. 3.- Gorgomyces honrubiae in pure culture (lactofuchsin mounts). A-B: mature conidial groups adhering to each other at their apical appendages (A) and base (B). C: conidiophore, arrows shows a constriction process on the conidium body and the basal cell. D-E: Detached conidia with appendages being evacuated. Bar: 20 µm.

x 1.5 µm with a short lateral peg, contents of the cell gelatinizing at a later stage and thus releasing the conidia. Conidia dispersed in water or trapped in foam individually or more typically in groups, adhering to each other at their mucous base or apical appendages; germinating readily from any cell on the main body.

COLLECTIONS EXAMINED

Single groups of conidia isolated from foam in Campamento San Juan stream, Riópar, Albacete, Spain. Roldán Nov. 1987 (MA-FUNGI 20840 holotype ex MUB AR 9761 Isotype. Other collections from the same locality and date (MUB AR 9765, MUB AR 9766).

Gorgomyces hungaricus Gönczöl & Révay (1985), type species, was only described from nature, and hence some important characters related with conidiogenesis may not have been seen. Unfortunately, according to Gönczöl (in litt.) the type is damaged and unserviceable. Nevertheless conidial morphology is so characteristic that the assignation of our species to *Gorgomyces* is unquestionable. *G. honrubiae* is clearly distinct from the type species in that, in the latter, the conidiogenous head is a terminal verticil composed of only conidiogenous cells, while here there is an incurving branching system; secondly, there is no evidence of a basal appendage of a cellular nature on the conidium; thirdly, the apical appendage, althought it appears to have a wall, is described as mucous, and develops by apical growth, while in our species the apical appendage is initiated by a localized constriction process on the fully developed cylindrical body of the conidium, followed by a collapse of the distal portion; fourthly, conidia of *G. hungaricus* are straight to sinuous while ours are sinuous or helical; lastly, they differ significantly in dimensions, i.e.: in *G. hungaricus* the conidial body measures 90-120 x 2.5-3.5 µm, while in *G. honrubiae* it does not exceed 45 x 2 µm. It is interesting that conidia of the type species have been seen attached to nematodes onleaf litter. Our species has so far been seen in nature only as conidia in foam.

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THE OCCURRENCE OF TUBER TEXENSE IN GEORGIA

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ABSTRACT

A hypogeous fungus found among roots in a pecan orchard represents the first report of a truffle from Georgia. It is identified as *Tuber texense* Heimsch. An illustrated description of the Georgia material is presented.

INTRODUCTION

Records of ascomycetes reported from Georgia have been maintained for over 70 years (Miller, 1941; Hanlin, 1963), and during that time *Elaphomyces* has been the only genus of hypogeous ascomycetes recorded from the state. In September, 1987, during a visit to a pecan orchard near Albany, Georgia, numerous ascomata were observed among roots of several large pecan trees [*Carya illinoiensis* (Wang.) K. Koch] that had been exposed by soil erosion caused by a recent rain. Several ascomata were taken to the laboratory and examined, and were subsequently identified as *Tuber texense*. As this is apparently the first report of a tuberaceous species from Georgia and since it differs slightly from previous descriptions, an illustrated description of the Georgia material is presented here.

MATERIALS AND METHODS

General observations and measurements of asci and internal tissues were made on fresh material mounted in water. Material to be sectioned was cut into 5 mm^2 blocks, fixed in formalin-propionic acid-alcohol, dehydrated through a tertiary butyl alcohol series, embedded in paraplast, sectioned at 6 or 10 μm and stained in iron hematoxylin. Sections to be examined under the scanning electron microscope were mounted on an 18 mm round cover glass, deparaffined in xylene, then the cover glass was mounted on a stub and sputter-coated with gold-palladium in a Hummer sputter coater (Gaudet and Kokko, 1984). Light micrographs were taken with a Nikon Optiphot on Kodak Technical Pan film 2415; scanning micrographs were taken on a Philips 505 SEM with Polaroid Type 55 P/N film. These procedures have been previously described in greater detail (Hanlin & Tortolero, 1988).

OBSERVATIONS AND DISCUSSION

Tuber texense Heimsch

Ascomata hypogeous, up to 5.5 cm across, oval to nearly globose, light brown to dark reddish-brown, surface smooth, often lobed, especially on one side (Fig. 1). Interior consisting of a gleba with light and dark veins surrounded by a cortex (= medullary excipulum) and an exterior layer (= ectal excipulum) of pigmented cells (Fig. 2). Cortex 240-280 μm thick, composed of three regions (Fig. 4, 8). Outermost 2-3 rows of cells angular (textura angularis), with somewhat

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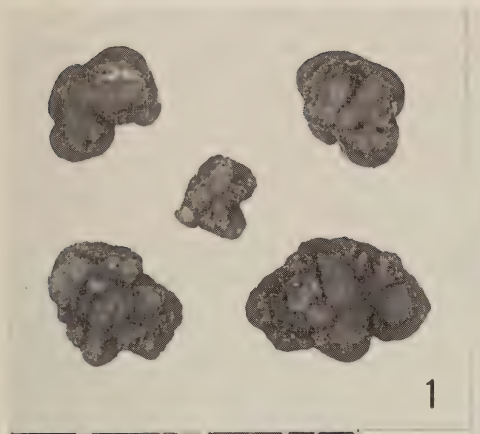
Fig. 1-7. *Tuber texense*. Fig. 2-7, paraffin sections of ascomata. Fig. 1. Five ascomata. X0.71. Fig. 2. Section through ascoma. X1.2. Fig. 3. Close-up of gleba with convoluted veins. X3.2. Fig. 4. Section through cortex showing outer region of pseudoparenchyma cells and inner region of parallel hyphae, and fertile vein with asci in interior. X262. Fig. 5. Section through outer portion of cortex showing outer rows of enlarged, pigmented cells. X514. Fig. 6. Section through sterile vein bordered by asci. X250. Fig. 7. Close-up of asci in fertile area. X266.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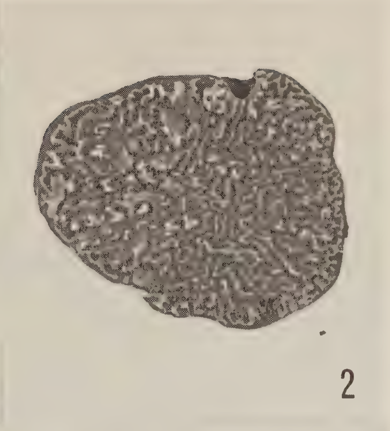
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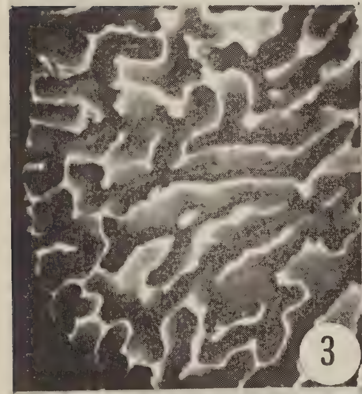
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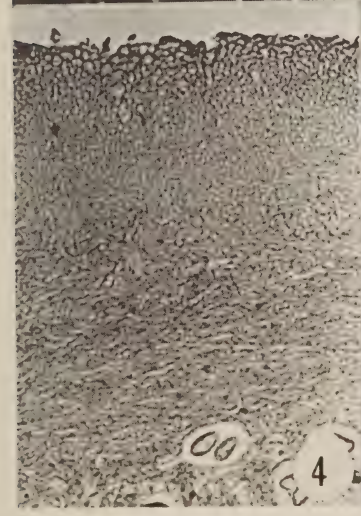
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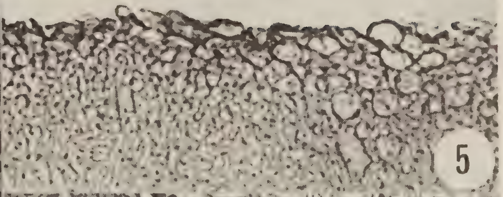
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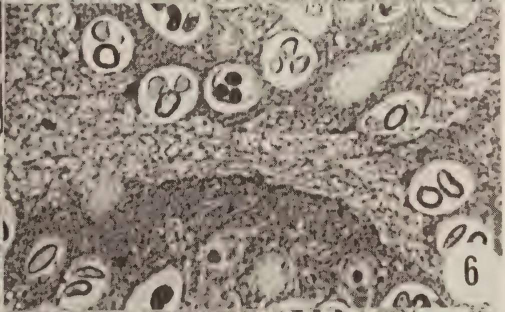
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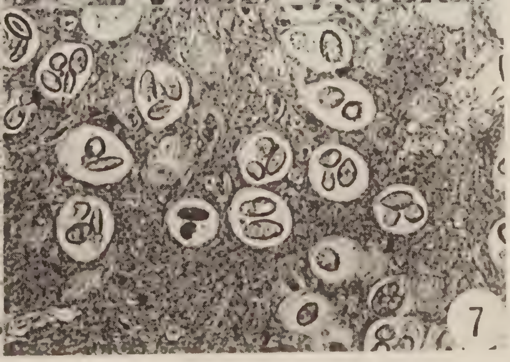
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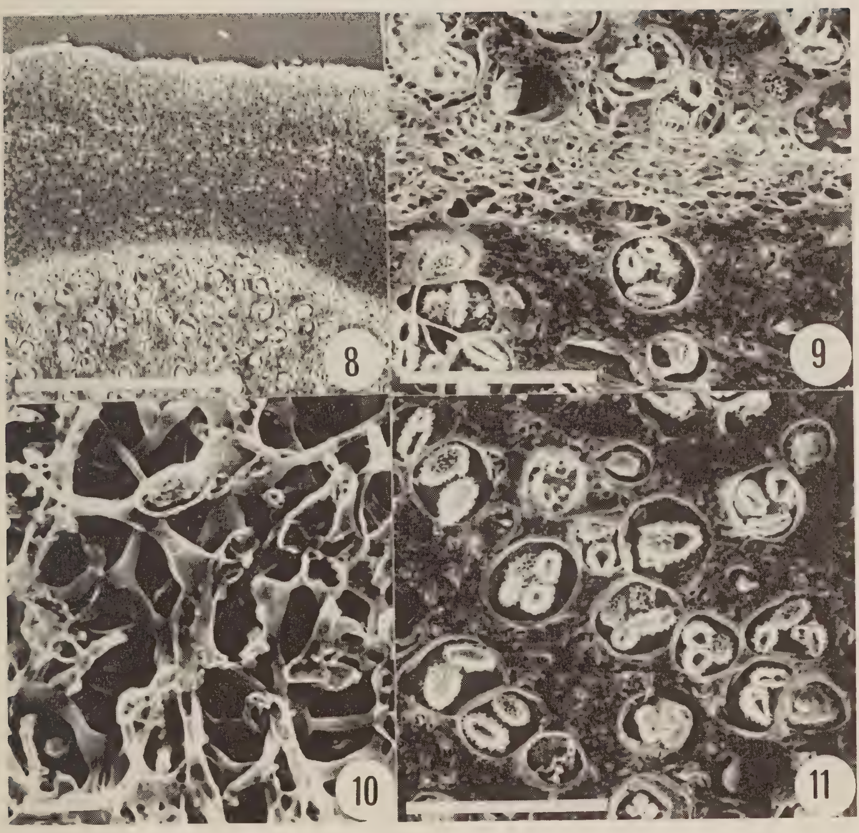
thickened, pigmented walls (Fig. 5). These surface cells intergrade into a region ca. 125 μm thick of small, compactly arranged pseudoparenchymatous cells with thin walls that vary in shape from globose to angular or short hyphal; the latter are oriented perpendicularly to the margin of the ascoma. Inner half of cortex (subcortex) composed of small, thin-walled, globose cells among tightly interwoven hyphae oriented parallel to periphery of ascoma; this region extends into gleba as sterile veins. Gleba composed of white, convoluted sterile veins (venae externae) bordered by brown fertile veins (venae internae) (Fig. 3). Sterile veins variable in width, branched, composed of hyaline, interwoven hyphae (textura intricata)(Fig. 10), becoming compressed by developing asci (Fig. 6, 9). Fertile veins brown, cells crowded, often indistinct and appearing as surrounded by mucus at maturity, enveloping numerous asci (Fig. 7, 11). Ascigerous areas in immature ascomata often separated by small veins of hyaline hyphae that form a loose, open network that is crushed as the asci develop. Asci unitunicate, thick- walled (Fig. 16), persistent, variable in size, (70)-88-(122) X (34)-48-(58) μm (including stipe), subglobose to ovoid, short- or long-stipitate [stipe (8)-22-(58) μm], containing 1-6 (usually 4) spores (Fig. 14-15). Ascospores unicellular, oval to occasionally subglobose, golden-brown at maturity, (22)-28-(36) X (16)-19-(24) μm, containing oil droplets, densely covered with spines that vary from minute to long and distinct (Fig. 17-18), up to 2 μm in length. The bases of the spines interconnect to form a reticulate pattern (Fig. 18).

Collected among roots of *Carya illinoiensis* (Wang.) K. Koch, Dougherty County, Georgia, September 18, 1987, T. B. Brenneman and P. F. Bertrand. Specimens deposited in GAM (#12742).

The material collected contained asci in all stages of maturity, permitting observation of ascus development. Asci arise from croziers formed from ascogenous hyphae (Fig. 12). The ascus mother cell expands to form a clavate ascus (Fig. 13), which then develops into a mature ascus with ascospores. Developing asci often have a clamp-like structure at the base that results from the fusion of the tip and basal cells of the crozier; this apparently forms the basis for the erroneous reports in the literature that tuberaceous asci possess clamp connections (Alexopoulos and Mims, 1979).



Figs. 8-11. SEM micrographs of *Tuber texense*. Fig.8. Section through cortex and portion of gleba. Bar = 1.0 mm. Fig. 9. Close-up of sterile vein bordered by asci. Bar = 0.1 mm. Fig. 10. Close-up of interwoven hyphae comprising sterile vein. Bar = 10 μm. Fig. 11. Asci in fertile vein. Bar = 0.1 mm.

The structure of our material agrees well with that described for *T. melanosporum* Vitt. (Parguey-Leduc et al., 1987), except for the large pyramidal scales that cover the surface of *T. melanosporum.*

Gilkey (1939) recognized a single species of *Tuber* in North America with spinose ascospores, *T. candidum* Harkness, to which she later added *T. harknessii* Gilkey (1954). A third species, *T. texense*, was described from Texas by Heimsch (1958); this species differs from *T. candidum* and *T. harknessii* in the formation of a reticulum on the spore surface that is associated with the spines. On the basis of these characteristics, our material is considered to be *T. texense.* In addition to Texas and Georgia, this species has also been found near Gainesville, Florida (James Kimbrough, personal communication).

Like our material, *T. texense* was found among roots at the base of a pecan tree. The occurrence of numerous ascomata in close association with roots of pecan suggests the possibility of a mycorrhizal association, but no direct evidence was found to support this. *Tuber melanosporum* has been demonstrated to form mycorrhizae with Corylus *avellana* L., *Quercus* spp., and other hardwood species (Delmas, 1976).

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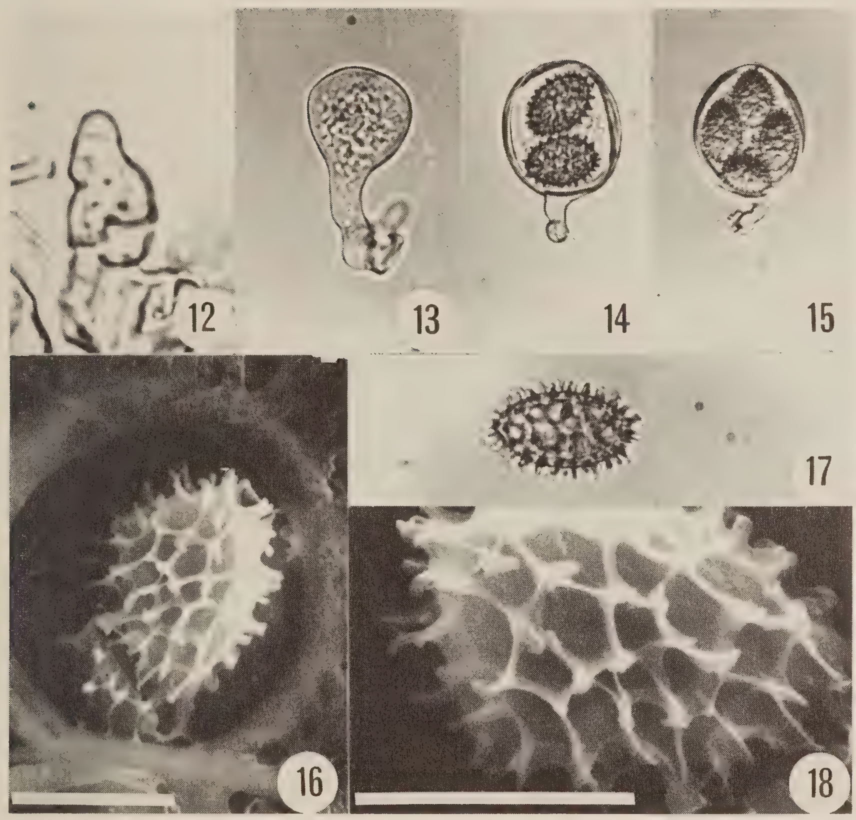
The assistance of J. O. Owens and P. F. Bertrand is gratefully acknowledged. The manuscript was reviewed by J. W. Kimbrough and R. G. Roberts.



Figs. 12-18. Light (Fig. 12-15, 17) and SEM (Fig. 16, 18) micrographs of *Tuber texense*. Fig. 12. Young ascus mother cell formed from crozier. X1680. Fig. 13. Young ascus. X1000. Fig. 14. Two-spored ascus. X475. Fig. 15. Four-spored ascus. X375. Fig. 16. Close-up of ascus with ascospore. Note thickened ascus wall. Bar = 10 μm. Fig. 17. Mature ascospore with spines. X950. Fig. 18. Close-up of ascospore showing spines with interconnecting bases. Bar = 10 μm.

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A SURVEY OF PILOBOLUS FROM YELLOWSTONE NATIONAL PARK

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INTRODUCTION

A survey of *Pilobolus* from Yellowstone National Park was undertaken to extend our current knowledge of the geographic distribution of this coprophilous fungus. While studies of *Pilobolus* indicate that the organism is widely found, those in the United States have been from eastern and midwestern states (1-3,7). None have been published describing the isolation of *Pilobolus* in the Rocky Mountains. This study was designed to determine whether *Pilobolus* is present in this region of North America.

METHODS AND MATERIALS

Isolates of *Pilobolus* collected in this study were all from fecal samples from herbivores within the boundaries of Yellowstone National Park, a site selected for this study because it contains many regions that are representative of the Northern Rocky Mountain area but are relatively undisturbed by domestic grazing and cultivation. The samples were collected during June and July of successive years from animals having access to native vegetation only.

Fresh (less than one hour old) fecal samples were collected in 20 different areas to examine for *Pilobolus*. Fecal samples from twenty-four bison (*Bison bison*), twenty-six elk (*Cervus canadensis*), twenty-two moose (*Alces alces*), six mule deer (*Odocoileus hemionus*), ten antelope (*Antilocapra americana*), six bighorn sheep (*Ovis canadensis*), and one horse (*Equus caballus*) were collected. These collections were made aseptically in plastic baggies and were transferred within hours to aseptic plastic cups as described by Foos and Royer (4). During the field period light and temperature conditions varied considerably, and cultures were maintained under shaded outdoor conditions. Upon return to the laboratory all cultures were maintained at room temperature under cool white fluorescent lights (2000 lx) with alternating 12 hour light and dark periods.

Isolates were obtained by removing single sporangia from the sides or tops of preparation dishes with sterile inoculating needles and transferring these sporangia to petri dishes containing dung agar. After initial isolations, hyphal tip transfers were used to maintain stock cultures.

Sporangia to be studied were collected from the lids of petri dishes with sterile inoculating needles and mounted in lactophenol. One hundred spores from each sporangium were examined and measured at 1000X using brightfield microscopy. Columella were observed by removing sporangia with microforceps.

Measurements of taxonomic structures were made from the original isolates on dung and from cultures growing on dung agar in the laboratory.

RESULTS

Seventy-two isolates of *Pilobolus* representing three species were recovered from 95 dung samples collected in Yellowstone National Park. These species were: *P. crystallinus*, *P. kleinii*, and *P. roridus*.

Pilobolus crystallinus (Wiggers) Tode: Fries (5)

Pilobolus crystallinus sporangiophores are 2 to 10 mm long, and are clear to pale yellow in color. Trophocysts develop submerged in the substratum and are usually 300 to 500 µm long. Sporangia are covered with a dark wall and range from 80-300 µm in diameter. Columella are papillate and extend deeply into the sporangia. Sporangiospores are pale yellow ellipses which measure 9.76 ± 0.60 (6-14.5) µm in length by 6.35 ± 0.65 (5-11.5) µm in width producing a length to width ratio of 1.53.

Pilobolus crystallinus was isolated in 18 locations in Yellowstone National Park from the dung of antelope, bighorn sheep, bison, elk, and mule deer.

Pilobolus kleinii van Tieghem (8)

Pilobolus kleinii sporangiophores measure 1 to 10 mm in length and arise from dark yellow turnip-shaped trophocysts 250-500 µm in diameter. The trophocysts are often partially submerged within the substratum. Sporangia have a dark, smooth wall measuring 80-450 µm across. The columella are papillate and extend deeply into the sporangia. Sporangiospores are yellow and elliptical, measuring 10.95 ± 0.21 (6.5-15) µm in length by 7.52 ± 0.67 (5.5-12.5) µm in width with a length to width ratio of 1.46.

Pilobolus kleinii was isolated in 35 locations in Yellowstone National Park from the dung of antelope, bighorn sheep, bison, elk, horse, and moose.

Pilobolus roridus (Bolt.) Pers. (6)

Pilobolus roridus sporangiophores are 1 to 8 mm long. Sporangia are dark, smooth, and hemispherical. They average 80-450 µm in diameter. Trophocysts are 250- 400 µm in diameter, nearly spherical, and bright orange in color. Sporangia are located on blunt rounded conical columella. Sporangiospores are pale yellow to colorless, oval in shape and measure 5.47 ± 0.23 (3-7.5) µm in length and 3.66 ± 0.39 (2.5-6.5) µm in width. The length to width ratio is 1.49.

Pilobolus roridus was isolated in 18 locations in Yellowstone National Park from the dung of antelope, bighorn sheep, elk, moose, and mule deer.

DISCUSSION

Pilobolus has been isolated in many places, but this is the first published report of *Pilobolus* from the Rocky Mountain Region of the United States. All fecal samples containing isolates of *Pilobolus* were recovered during summer months from seven different species of herbivores. These collections were of fresh material made several miles inside the Park boundaries. Of the ninety-five samples collected, seventy-one contained one or more isolates of *Pilobolus*. Twenty-two of twenty-four fecal samples from bison contained *Pilobolus*, as did five of twenty-two from moose, five of six from mule deer, twenty- five of twenty-six from elk, eight of ten from antelope, five of six from bighorn sheep, and the sample from the horse. Overall, more than seventy-five percent of the fecal samples contained isolates of *Pilobolus* indicating that this fungus is widely distributed among the different herbivores.

It is not possible to make correlations between collecting sites in the Park and the particular species of *Pilobolus* found, each having been found in at least 18 different locations. Nor is it possible to generalize about a particular species of herbivore and a particular species of *Pilobolus*. All three species of *Pilobolus* isolated in this study were found in fecal samples of elk, antelope and bighorn sheep, while bison, moose and mule deer each contained two species. The species of *Pilobolus* found in Yellowstone are well distributed throughout the geographic area and the various species of herbivores in which they are found.

It might be anticipated that in a study of this size a larger number of *Pilobolus* species would have been recovered. In other surveys four to six species have been isolated. The recovery of only three species may indicate that the environmental factors, particularly climatic conditions, restrict growth of other species of *Pilobolus*. However, with three-fourths of the fecal samples collected containing isolates of *Pilobolus,* it is clear that there are abundant representatives of the genus, even if only three species are present.

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TWO NEW SPECIES OF PARMELIA (PARMELIACEAE, LICHENES), FURTHER NEW COMBINATIONS AND NOTES, AND ADDITIONAL NEW LICHEN RECORDS FROM SOUTHERN AFRICA

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ABSTRACT

Two new species of *Parmelia* (Parmeliaceae, lichenized Ascomycetes), *P. agamalis* Brusse and *P. geckonalis* Brusse, are described from southern Africa. Five new names are proposed: *Parmelia mixta* Brusse, *P. perfunctata* Brusse. *P. phyllodactylaris* Brusse, *P. salax* Brusse, and *P. tantillum* Brusse. Three new combinations are made: *Parmelia protodysprosa* (Hale) Brusse, *P. saniensis* (Hale) Brusse, and *P. umtamvuna* (Hale) Brusse. Notes on eight species in the Parmeliaceae pertinent to the flora of southern Africa are given. Five lichen species are newly recorded for southern Africa.

NEW SPECIES

PARMELIA AGAMALIS Brusse, *sp. nov.* Fig. 1

Thallus foliosus, saxicola, adnatus, ad 6 cm diametro, 60–170 µm crassus. *Lobi* elongati, 1–3 mm lati. *Thallus superne* cinereus, nitidus, emaculatus, isidiatus, isidiis parvis, usque ad 0,1 mm crassis. *Cortex superior* 9–12 µm crassus. *Stratum gonidiale* 15–35 µm crassum, algis *Trebouxiis*, 5–16,5 µm diametris. *Medulla* alba, 25–110 µm crassa. *Cortex inferior* 6–11 µm crassus. *Thallus inferne* piceus. *Rhizinae* simplices, sparsae. *Apothecia* non visa. *Pycnidia* hyalina, circa 150 µm profunda et circa 90 µm lata. *Pycnidiosporae* hyalinae, aciculares, 4–6 × 0,8 µm. *Thallus* atranorinum, acidum hyposticticum, acidum hyposalazinicum, acidum sticticum, acidum hypoconsticticum et acidum consticticum continens.

TYPUS—SOUTH AFRICA, Cape Province, **3318** (Cape Town): Bothmaskloof Pass near Riebeeks Kasteel, Porseleinberg, on Table Mountain Sandstone outcrops on NW slope, alt. 300 m (–**BD**). *F. Brusse 2782*, 28.iv.1981 (**PRE**, holo-; **COLO**, **LD**, iso-). Figura 1.

Thallus foliose, saxicolous, adnate, to 6 cm across, 60–170 µm thick. *Lobes* elongate, 1–3 mm wide. *Upper surface* grey, nitid, emaculate, isidiate, isidia small, up to 0,1 mm thick. *Upper cortex* 9–12 μm thick. *Algal layer* 15–35 μm thick, algae *Trebouxia*, 5–16,5 μm diam. *Medulla* white, 25–110 μm thick. *Lower cortex* 6–11 μm thick. *Under surface* black. *Rhizines* simple, sparse. *Apothecia* not seen. *Pycnidia* hyaline, about 150 μm deep and about 90 μm wide. *Pycnidiospores* hyaline, needle-like, 4–6 × 0,8 μm. *Chemistry*: atranorin in the cortex; hypostictic, hyposalazinic, stictic, hypoconstictic and constictic acids in the medulla.

Etymology: *agamalis* (L) = relating to *Agamas*, a genus of lizards, often with some blue colouration on the head; specifically the rock agama, *Agama atra*. These and other saxicolous lizards, may play a role in the spreading of vegetatively propagating lichens such as *Parmelia agamalis*, as they scuttle over the rocks on which these lichens grow.

There are no known species of the section *Paraparmelia*, that are isidiate, with a black lower surface and contain the hypostictic acid group with or without the stictic acid group of substances, in southern Africa. *Parmelia ischnoides* Kurok. (Hale 1976), may well be related, but this species is smaller and contains only the stictic acid group.

On the other hand, there are several isidiate *Paraparmelias* in Australia with black lower surfaces, containing the hypostictic acid group with or without the stictic acid group. Of these, *Parmelia numinbahensis* Elix (1979) is undoubtedly the closest relative of this new species, but contains only the hypostictic acid group, without stictic and constictic acids. The lobes of *P. numinbahensis* also seem longer and narrower, than those of *P. agamalis*, but this may depend on the range of variation displayed by these two species, which at this time is unknown.

Parmelia neoquintaria (Hale) Elix & Stevens, the first hypostictic acid containing *Paraparmelia* discovered (Hale 1976), is more distantly related, having a pale lower surface, and a looser thallus (again depending on the range of variation). Based on my experience with southern African lichens, these habit differences are probably not significant.

The recently described, *Paraparmelia subtropica* Elix & Johnston (1986), is also isidiate, with a black lower surface, but is a small lobed, tightly adnate lichen (lobes 0,4–1,0 mm wide), with only traces of hypostictic and hyposalazinic acids. The major component of *P. subtropica* is norstictic acid, and a trace of connorstictic acid is also present. *Paraparmelia subtropica* is therefore more distantly related to *Parmelia agamalis*, and is probably more closely related to *Parmelia ischnoides*.

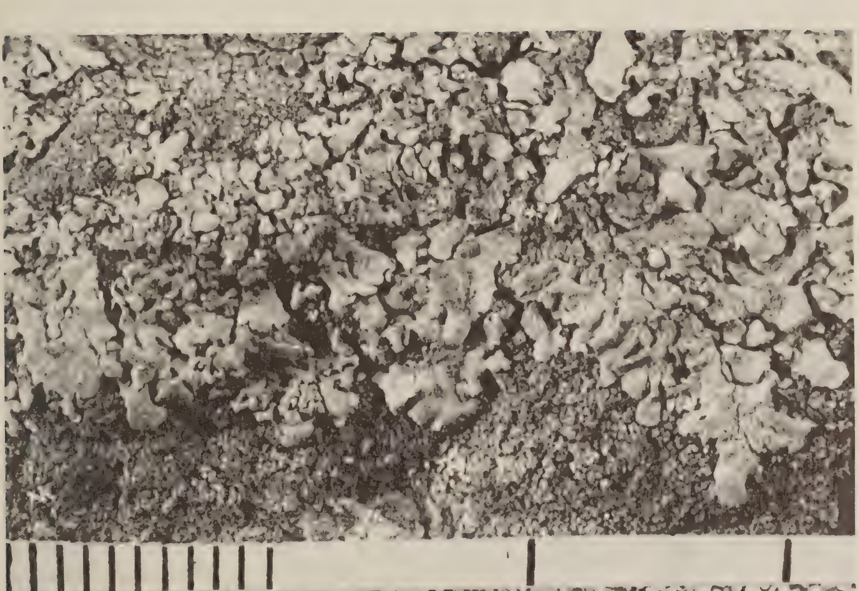
The type material (particularly the holotype in **PRE**) has white short barrel shaped insect eggs with umbonate lids, laid on it and the adjacent rock, and are probably those of a chinch bug (Lygaeidae).

The holotype specimen is also growing with *Parmelia (Neofuscelia) caliginosa* Essl.

At present this new species is only known from the type collection, near Riebeeks Kasteel in the south-western Cape Province.

PARMELIA GECKONALIS Brusse, *sp. nov.* Fig. 2

Thallus subcrustosus, saxicola, ad 3 cm diametro, 60–140 μm crassus. *Lobi* elongati, 0,3–1,3 mm lati. *Thallus superne* flavo-viridis, opacus vel grosse pruinosus, pustulatus. *Pustulae* capitatae, substipitatae, ad 1,5 mm diametris. *Cortex superior* 8–15 μm crassus. *Stratum gonidiale* 15–45 μm crassum, algis *Trebouxiis,* 5,5–18 μm diametris. *Medulla* albida, 20–95 μm crassa. *Cortex inferior* 4,5–8 μm crassus. *Thallus inferne* pallide brunneus. *Rhizinae* simplices, 30–60 μm crassae. *Apothecia* et *pycnidia* non visa. *Thallus*



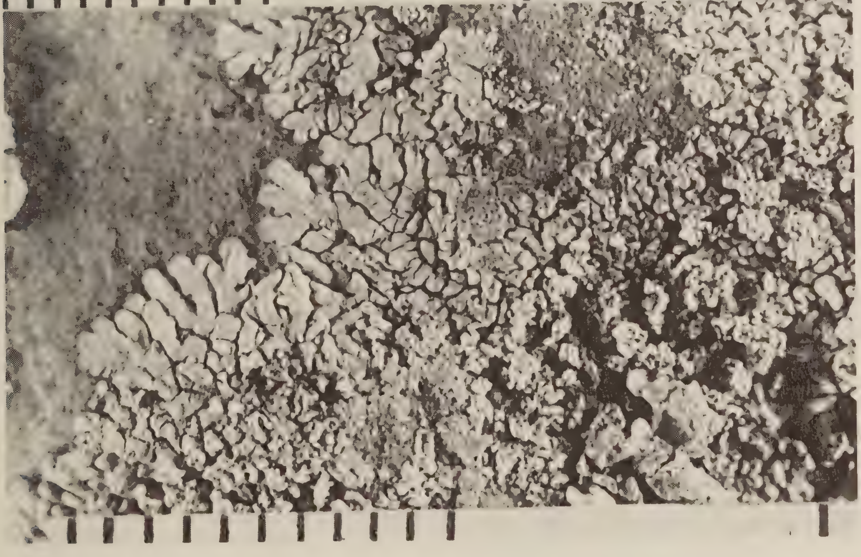


FIGURE 1.—*Parmelia agamalis* Brusse, habit. *F. Brusse 2782*. Scale in mm and cm.

FIGURE 2.—*Parmelia geckonalis* Brusse, habit. *F. Brusse 5536*. Scale in mm and cm.

acidum usnicum, acidum salazinicum, et acidum norsticticum (tr.) continens.

TYPUS—SOUTH AFRICA, Cape Province, **3218** (Clanwilliam): 8 km W of Olyvenboskraal, Witelskloof. On large Table Mountain Sandstone boulder outcrop, on SW side. On outer edge of roof of rock overhang, high up on outcrop. Alt. 500 m (–**BD**). *F. Brusse 5536*, 25.iii.1988 (**PRE**, holo-; **BM**, iso-). Figura 2.

Thallus subcrustose, saxicolous, to 3 cm across, 60–140 μm thick. *Lobes* elongate, 0,3–1,3 mm broad. *Upper surface* yellow-green, matt to coarsely pruinose, pustulate. *Pustules* capitate, substipitate, to 1,5 mm across. *Upper cortex* 8–15 μm thick. *Algal layer* 15–45 μm thick, algae *Trebouxia,* 5,5–18 μm diam. *Medulla* whitish, 20–95 μm thick. *Lower cortex* 4,5–8 μm thick. *Lower surface* pale brown. *Rhizines* simple, 30–60 μm thick. *Apothecia* and *pycnidia* not seen. *Chemistry*: usnic acid in the cortex; salazinic and norstictic (tr.) acids and the 'chalybaeizans unknown' in the medulla.

Etymology: *geckonalis* (L) = relating to geckos. Since this lichen grows on the roofs of rock overhangs, only geckos could spread this lichen species, by the adhesion of pustular fragments on the foot pads and underbody.

Parmelia geckonalis is a unique species, and has no close relatives. It does, however, resemble *P. mougeotii* Schaer. ex Dietr. *P. mougeotii* contains the stictic acid group only and has a black lower surface, whereas *P. geckonalis* contains salazinic acid and the 'chalybaeizans unknown' and has a pale lower surface. *P. geckonalis* also has a coarse pruinose upper surface and grows on the roofs of rock overhangs, whereas *P. mougeotii* is glossy above and does not grow on the roofs of rock overhangs. *Xanthoparmelia pustulifera* Hale (1986) is not much different from *P. mougeotii* Schaer. ex Dietr. and is probably a synonym of it. The presence of *P. mougeotii* (or *X. pustulifera* Hale) in the Cape Province has yet to be confirmed.

Parmelia phyllodactylaris Brusse (synonym: *Xanthoparmelia eruptens* Hale (1987)) is another small lichen from the roofs of rock overhangs, but this lichen has dactyls and a black lower surface, and contains evernic and lecanoric acids in the medulla.

At present this species is known only from the type locality, Witelskloof near Clanwilliam.

NEW COMBINATIONS

Since the crucial proposal 291A (McNeill 1986), concerning lectotypification was not passed at the Berlin Congress (Greuter & McNeill 1987, McNeill 1987), it is still better to use *Parmelia*, typified by *Parmelia conspersa* Ach., as was first done by Clements & Shear in 1931 (Brusse 1988a). The following new combinations and new names are therefore proposed:

Parmelia mixta Brusse, *nom. nov*.

Basionym: *Xanthoparmelia paradoxa* Hale, Mycotaxon **29**: 261, 1987. (non *Parmelia paradoxa* Hale, Phytologia **27**: 1, 1973).

Parmelia perfunctata Brusse, *nom. nov*.

Basionym: *Xanthoparmelia natalensis* Hale, Mycotaxon **29**: 259, 1987. (non *Parmelia natalensis* Steiner & Zahlbruckner, Bot. Jb. **60**: 515, 1926).

Parmelia phyllodactylaris Brusse, *nom. nov*.

Basionym: *Xanthoparmelia eruptens* Hale, Mycotaxon **29**: 254, 1987. (non *Parmelia eruptens* Kurokawa in Hale & Kurokawa, Contrib. U.S. natn. Herb. **36**: 153, 1964).

Etymology: *phyllodactylaris* (L) = relating to geckos of the genus *Phyllodactylus*, in particular the striped gecko, *Phyllodactylus lineatus rupicolus*. Since this lichen grows on the underside of rock overhangs, only geckos and perhaps bats could be important in dispersing this vegetatively reproducing (dactyls) lichen.

Parmelia protodysprosa (Hale) Brusse, *comb. nov.*

Basionym: *Xanthoparmelia protodysprosa* Hale, Mycotaxon **29**: 262, 1987.

Parmelia salax Brusse, *nom. nov.*

Basionym: *Xanthoparmelia applicata* Hale, Mycotaxon **30**: 320, 1987. (non *Parmelia applicata* (Stiz.) Esslinger, Bryologist **76**: 307, 1973).

Synonym: *Xanthoparmelia rugulosa* Hale, Mycotaxon **30**: 328, 1987. (non *Parmelia rugulosa* (Nyl.) Bab. & Mitt. in Hooker, Flora Tasmaniae **2**: 348, 1860; nec *Parmelia rugulosa* (Müll. Arg.) Vainio, Résultats de Voyage du S.Y. Belgica, Botanique: 14, 1903).

Etymology: *salax* (L) = lustful, lecherous or sexy, in allusion to the dense covering of apothecia often displayed by this species.

Parmelia saniensis (Hale) Brusse, *comb. nov.*

Basionym: *Xanthoparmelia saniensis* Hale, Mycotaxon **27**: 596, 1986.

Parmelia tantillum Brusse, *nom. nov.*

Basionym: *Xanthoparmelia inconspicua* Hale, Mycotaxon **29**: 256, 1987. (non *Parmelia inconspicua* Sprengel, Mantissa Prima ad Floram Halens.: 57, 1807).

Parmelia umtamvuna (Hale) Brusse, *comb. nov.*

Basionym: *Xanthoparmelia umtamvuna* Hale, Mycotaxon **29**: 266, 1987.

NOTES ON SOME PARMELIACEAE

Xanthoparmelia brevilobata Hale, Mycotaxon **29**: 253, 1987.

The chemistry of this species is identical to that of *Parmelia saniensis* (Hale) Brusse, containing the pigments usnic acid and skyrin, and hypostictic, hyposalazinic and hypoconstictic acids, in addition to a minor amount of lividic acid, and a pale UV_{360}+ substance similar to the 'chalybaeizans unknown'. However, this species does not have the bumps on it that *P. saniensis* has. If these bumps on the type of *P. saniensis* are abnormalities, then *X. brevilobata* is certain to be a synonym of *P. saniensis. Xanthoparmelia naudesnekia* Hale, may be a chemosyndromic variant of this species, containing stenosporonic acid instead of lividic acid.

Xanthoparmelia diffractaica Hale, Mycotaxon **29**: 254, 1987.

This lichen contains major amounts of the 'chalybaeizans unknown' and barbatic acid, and a minor amount of 4-O-demethylbarbatic acid, in addition to the salazinic, diffractaic and usnic acids originally reported. This lichen is identical to *Parmelia lesothoensis* (Hale) Brusse, except for a slightly larger amount of barbatic acid present.

Parmelia lesothoensis (Hale) Brusse, Mycotaxon **31**(2): 539, 1988.

Synonyms: *Xanthoparmelia lesothoensis* Hale, Mycotaxon **27**: 582, 1986.
: *Xanthoparmelia diffractaica* Hale, Mycotaxon **29**: 254, 1987.

Although Brusse (1988b) detected the 'chalybaeizans unknown' in this lichen, in addition to usnic, salazinic and diffractaic acids as originally reported, he did not notice the minor amount of barbatic acid hidden by usnic acid on plates B and C, and the trace of 4-O-demethylbarbatic acid. Slightly larger amounts of barbatic acid occur in the type of *Xanthoparmelia diffractaica* Hale, but otherwise there are no differences between these two lichens.

Parmelia perfunctata Brusse

Synonym: *Xanthoparmelia natalensis* Hale, Mycotaxon **29**: 259, 1987.

This lichen also contains barbatic acid in fairly large quantities and a trace of 4-O-demethylbarbatic acid in addition to the diffractaic, physodalic, succinoprotocetraric, fumarprotocetraric and usnic acids originally reported. This lichen is very similar to the pantropical *P. adplanata* Müll. Arg. (Syn: *P. subramigera* Gyeln.), but contains diffractaic and barbatic acids in addition to the usual constituents. Distributional patterns may clarify the status of this species.

Parmelia saniensis (Hale) Brusse

Synonym: *Xanthoparmelia saniensis* Hale, Mycotaxon **27**: 596, 1986.

This lichen contains a pale $UV_{360}+$ substance similar to the 'chalybaeizans unknown, as well as lividic acid in addition to skyrin, usnic, hypostictic, hyposalazinic and hypoconstictic acids as originally reported. The chemistry is identical to that of *X. brevilobata*, but *P. saniensis* is 'isidiate'. These 'isidia' are too large and variable in size to be called dactyls even, but may actually be bullate regrowths from damaged lobes. For the time being the type specimen of *P. saniensis* is regarded as an abnormal, damage induced growth form, while the type specimen of *X. brevilobata* is considered the normal condition.

As mentioned previously, *X. naudesnekia* Hale, reported to contain stenosporonic rather than lividic acid, may be a chemosyndromic variant of *P. saniensis* Hale. A final verdict, will depend on a TLC analysis of the type material.

Parmelia spissa Brusse, Mycotaxon **31(1)**: 158, 1988.

Additional isotypes of this species have been deposited at **BM, COLO, UPS** and **US**. Further specimens of *F. Brusse 4592* (paratypes) have been deposited at **UC, UPS** and **US**, over and above the original **BM, COLO, LD** and **PRE**.

Parmelia tantillum Brusse

Synonym: *Xanthoparmelia inconspicua* Hale, Mycotaxon **29**: 256, 1987.

A thin-layer chromatographic study of this lichen revealed the presence of usnic, hypostictic, hyposalazinic and hypoconstictic acids, and the same unidentified pale $UV_{360}+$ substance, similar to the 'chalybaeizans unknown' that occurs in *P. saniensis* (Hale) Brusse. Dull reddish pigments were not detected.

Parmelia adhaerens Nyl, is closely related, but lacks hyposalazinic acid and contains stictic acid instead.

Parmelia umtamvuna (Hale) Brusse

Synonym: *Xanthoparmelia umtamvuna* Hale, Mycotaxon **29**: 266, 1987.

An isotype specimen (**PRE**) contains stictic, constictic and usnic acids, but diffractaic acid is not present as originally reported. However, barbatic acid and a trace of 4-O-demethylbarbatic acid are present.

ADDITIONAL NEW LICHEN RECORDS

Recently Kärnefelt (1987) reported a number of interesting new generic and species records for southern Africa, based on the high altitude collections of Ms. Elsie Esterhuysen. I recently took the opportunity to examine several high altitude localities personally, through the kind permission of the landowners, post-office authorities and forestry officials concerned, and found several further new generic and species records for the southern African lichen flora, over and above those reported previously (Brusse 1988b).

Acroscyphus sphaerophoroides Lév.

SOUTH AFRICA, CAPE PROVINCE.—**3319** (Worcester): Summit of Jonaskop in the Riviersonderend mountains, near Villiersdorp. On SE side, on top of Table Mountain sandstone outcrop in prominent position, and fully exposed. Sporadic. Alt. 1 640 m (–**DC**). *F. Brusse 5457*, 21.iii.1988 (**BM, LD, PRE, UPS**).

According to Tibell (1984) this is a rare but widespread lichen, occurring at high altitudes between the latitudes 43° N and 43° S. While the latitude of the present locality is within this range, the altitude is comparatively low (1 640 m), being much less than 4 000 m. It seems as though this lichen may occur at lower altitudes at higher latitudes. This is the first record of this lichen from the African continent, as it is known from Peru, Patagonia, Mexico, Bhutan, Yunnan, Sikang and Japan. Although sporadic in occurrence at any particular locality, *A. sphaerophoroides* does not seem to be rare in the Riviersonderend Mountains, because it was collected again at Galgeberg, 16 kilometres to the east of Jonaskop, as the crow flies. That material was badly burned in a recent bush fire and is not cited here.

Gomphillus calicioides (Delise) Nyl.

SOUTH AFRICA, CAPE PROVINCE.—**3318** (Cape Town): South side of Table Mountain, SSW slope overlooking Hely-Hutchinson Reservoir, on *Hypnum cupressiforme* Hedw. low down on rock. Growing with *Megalospora tuberculosa* (Fée) Sipman. Alt. 950 m (–**CD**). *F. Brusse 5422b*, 19.iii.1988 (**PRE**).

In an effort to extend the known range of *Psathyrophlyctis serpentaria* Brusse, a yellow granular lichen was collected on *Hypnum cupressiforme* Hedw. low down on a rock, on the south side of Table Mountain. The apotheciate material turned out to be *Megalospora tuberculosa* (Fée) Sipman, while the more olive-yellow material was *Psathyrophlyctis serpentaria*, as judged by the chemistry. In addition to these lichens, *Gomphillus calicioides*, was also found. (Jacques van Rooy kindly named the moss).

Hypogymnia subphysodes (Krempelh.) Filson

SOUTH AFRICA, CAPE PROVINCE.—**3318** (Cape Town): East side of Table Mountain, from Fernwood Buttress to Erica Buttress. On S sides of TMS outcrops and boulders, on steep E slope. Fairly common near crevices and in rock pockets. Alt. 1 000 m (–**CD**). *F. Brusse 5424*, 19.iii.1988 (**BM, LD, PRE**). **3319** (Worcester): Jonaskop in the Riviersonderend Mountains near Villiersdorp. On S Table Mountain Sandstone cliffs. Tends to occur near crevices and in rock pockets. Alt. 1 640 m (–**DC**). *F. Brusse 5471*, 20.iii.1988 (**BM, LD, O, PRE, UPS**). Lit. Elix (1980).

Hypogymnia subphysodes (Krempelh.) Filson var. *austerodioides* Elix

SOUTH AFRICA, CAPE PROVINCE.—**3318** (Cape Town): East side of Table Mountain, from Fernwood Buttress to Erica Buttress. On S sides of TMS outcrops and boulders, on steep E slope. Fairly common near crevices and in rock pockets. Alt. 1 000 m (–**CD**). *F. Brusse 5419*. 19.iii.1988 (**PRE**). Lit. Elix (1980).

Parmelia (Xanthoparmelia) kurokawae Hale

SOUTH WEST AFRICA/NAMIBIA.—**2017** (Waterberg): Waterberg trail at campsite, on sandstone rocks at S base of cliffs (–**CA**). *F. Brusse 4219*, 1984.03.22 (**PRE, LD**).

Porpidia urbanskyana (Zahlbr.) Brusse

SOUTH AFRICA, NATAL.—**2828** (Bethlehem): 31 km S of Phuthaditjhaba (Witsieshoek), summit of Western Buttress (Mont-aux-Sources), on S basalt face, in heavy seepage, on gentle S slope. Alt. 3 080 m (–**DB**). *F. Brusse 5548*, 5.iv.1988 (**BM, PRE**).

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POLLUTION ATMOSPHERIQUE ET LICHENS DANS LA VILLE DE SANTIAGO DU CHILI

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> La Constitución asegura a todas las personas: El derecho a vivir en un medio ambiente libre de contaminación.
> Es deber del Estado velar para que este derecho no sea afectado, y tutelar la preservación de la naturaleza.
> La ley podrá establecer restricciones específicas al ejercicio de determinados derechos o libertades para proteger el medio ambiente.
>
> Art. 19. Nº 8
> Constitución Política de la
> República de Chile, 1980

ABSTRACT

With the aim of finding biological indicators of air pollution an inventory of lichens collected in different areas of Santiago de Chile was made. The distribution of lichens is discussed in relation to geographic situation of the city, its climatic characteristics and air polluants. Althougth the distribution of lichens in the city varied according of species, lichens were present in all areas studied.

INTRODUCTION

Pendant les dernières années les habitants de Santiago sont preoccupés par la pollution atmosphérique accentuée que chaque année semble aller en augmentation.

Les autorités du Ministerio de Salud à travers du Laboratorio de Contaminación Atmosférica ont effectué des mesures des contaminants en différentes lieux de la ville. En plus, il contrôle periódiquement les sources fixes des contaminants. D'autre part, les autorités du Ministerio de Transporte y Telecomunicaciones ont adopté des dispositions qui restreignent la circulation véhiculaire dans l'aire centrale de la ville selon dernier numéro de la matriculation, une fois par semaine, de Lundi à Vendredi et a disposé que toute véhicule avec moteur à explosion doit être contrôlée, au moins, une fois par an dans ses aspects mechaniques et d'emission des contaminants (% CO). Mais, tous le deux organismes n'ont pas obtenue la disminution des indices de contaminants atmosphériques.

Le problème de la pollution atmosphérique qui affecte beaucoup des villes a originé différents publications. En Santiago, par example, on a analysé des aerosols de l'aire urbaine et suburbaine en trouvant 25 èlèments chimiques (Préndez et al., 1984).

L'action du CO de l'air dans l'accroissement des lichens a été étudié en Anglaterre et Gales par Hawksworth & Rose (1970); les lichens comme bioindicateurs naturelles ont été étudié en relation aux éléments stables et radiactives de l'air par Looney & al. (1986). Les cryptogames ont été employées comme organismes moniteurs de pollution de l'air par metaux, selon Rasmussen et al. (1980) et la ville de Caracas fût l'objet d'une étude de la distribution des lichens d'accord au degré des contaminants atmosphériques par Vareschi & Moreno (1973).

Etant donnée que la ville de Santiago présente une pollution atmosphérique elevée, fait que je décidais il y a dejà quelques années de récolter les lichens qui se trouvaient dans les différents lieux, avec l'objet de determiner jusqu'à quel point la pollution atmosphérique aurait un effect negatif sur les populations licheniques.

En ce travail on montre la distribution des lichens dans l'aire urbaine de Santiago et les indices de contaminants mesurés par les Stations distribuées dans la ville.

SITUATION DE LA VILLE DE SANTIAGO

La ville de Santiago est située dans une depression du Chili centrale comprise entre les 32º 10' - 32º 54' S et les 70º 29' - 70º 00 W. Le dimension N-S de cette vallée sont 83 km et sa latitude E-W de 54 km environ. Au Nord la depression est limitée par un cordon de collines qui forment la Cuesta El Manzano, au Sud par l'Angostura de Paine, au l'Est par la Cordillère des Andes. Les sommets plus importants de cette Cordillère sont le Cerro Colocalán (2.540 m), le Cerro La Provincia (2.731 m), le Cerro San Ramón (3.249 m), le Cerro Los Cristales (3.057 m) et le Cerro Pabellones (2.497 m). Par l'Ouest cette depression est limitée par le cordon montagneux de la Cordillera de la Costa et ses sommets plus importants sont le Cerro Roble Alto (2.027 m), le Cerro Perro Muerto (1.391 m) et le Cerro Cantillana (2.281 m). La ville de Santiago est situé aux 33º 27' S et 70º 38' W, à 600 m (Fig. 1).

CLIMAT

D'accord aux indices de Thorthwaite, Santiago a un climat modéré semi-aride, avec un hiver bénigne et un été sec.

CARACTERISTIQUES DES CONSTITUANTS CLIMATIQUES

a) Vents: La frequence des directions du vent en Juin et Janvier, dans la période 1831-1960, avec trois observations par jour (08 hrs. 14 hrs. et 20 hrs.) nous indique que au Juin les vents du SW occurrent dans le 12.1%, il'a un période de calme dans le 70.6% et le reste dans d'autres directions. En général, les vents qui dominent procedent du SW pendant le jour et de l'Est dans la nuit avec une faible vitesse. Les vents provoquent des inversions thermiques frécuentes en hiver qui souvent subsistent toute la journée. Ces inversions causent la formation d'un "plafont" qui en été arrive aux 1.000 m et en hiver, entre les 300 et 400 m sur la ville, dessous duquel l'air contaminé est gris ou obscur. On a observé en Août dans un jour de grande inversion thermique, la température au niveau du sol est de 4º C et dans la sommet de l'inversion (1.000 m) est de 16º C. La masse supérieure d'air froid empêche que les contaminants montent aux couches supérieures de l'atmosphère restant retenus au-dessous d'elles (Fig. 2, 3, 4 et 5).

La pollution atmosphérique est plus intense lorsque se présentent des inversions fortes de témperature avec des vents faibles dans les masses baisses de la atmosphère.

b) Precipitations: Les precipitations sont, en moyenne annuelle, de 329.8 mm et les mois de Mai à Août, les plus pluvieux, avec une moyenne de 64 mm.

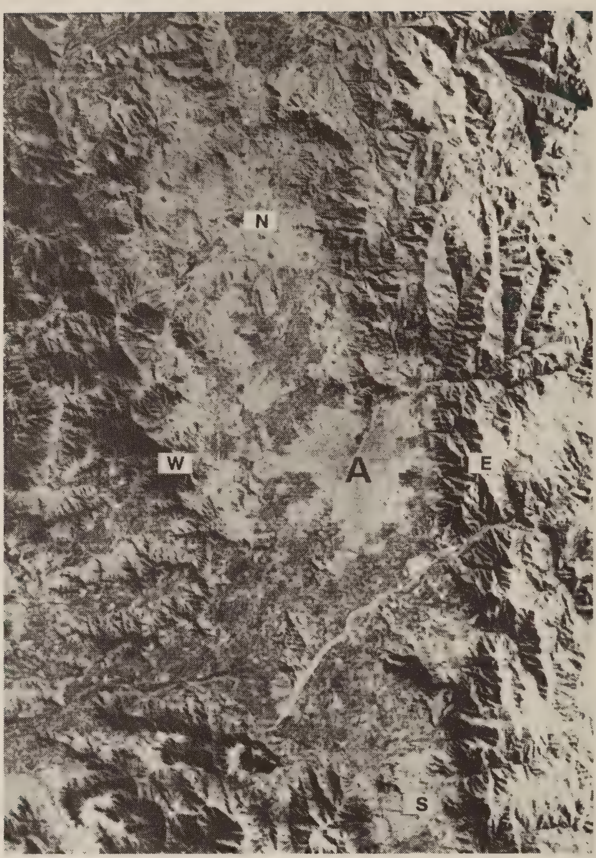


Fig. 1.- Région centrale du Chili. A: Ville de Santiago dans la vallée centrale et ses limits N-S-E-W. Image captée par le Satélite Landsat-2, le 22-III-1975, à 09 hrs. 57 min. 20 sec. à une altitude de 900 km (Courtaisie d'Instituto Geográfico Militar, Santiago).

c) Témperature et Humidité Relative de l'Air: La témperature moyenne annuelle est de 14.5º C et la humidité moyenne relative de l'air 83% (08 hrs), 48% (14 hrs) et 64% (20 hrs).

PROTECTION DE L'ENVIRONNEMENT

Par disposition du Ministerio de Salud on a communiqué les normes sanitaires destinées à prévoir et à contrôler la pollution au Chili. Dans cette resolution on défine la pollution atmosphérique comme "la presence dans l'air d'un ou plus contaminants ou quelconque combination d'eux en

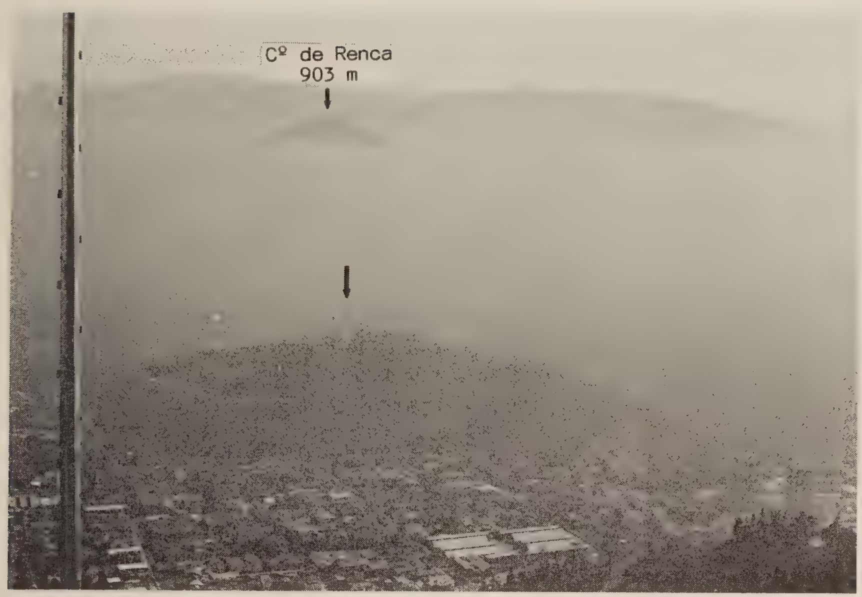

Cº de Renca
903 m

Fig. 2.- Vue W de la ville de Santiago couverte par le nuage de contaminants, depuis le Cerro San Cristóbal, 880 m (7-V-1987).

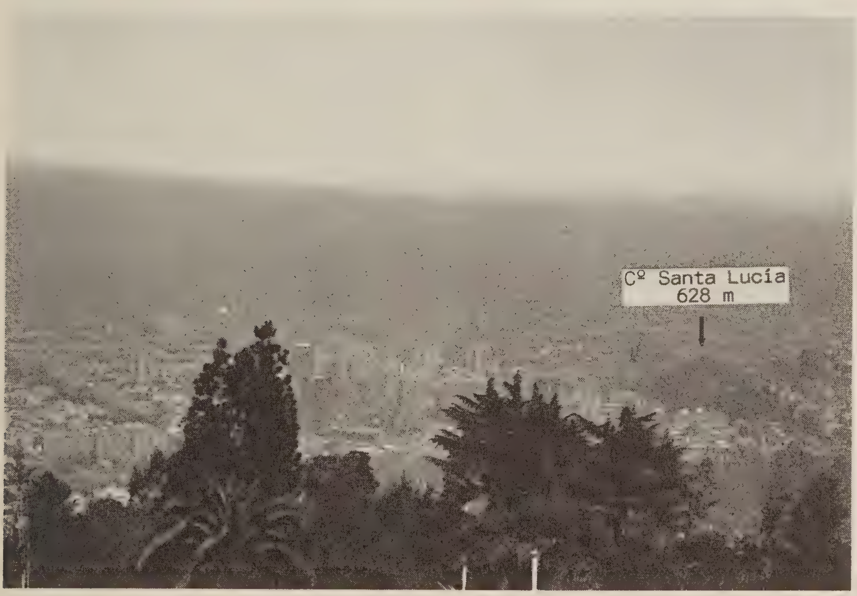

Cº Santa Lucía
628 m

Fig. 3.- Vue S de la ville de Santiago couverte par le nuage de contaminants, depuis le Cerro San Cristóbal, 880 m (7-V-1987).

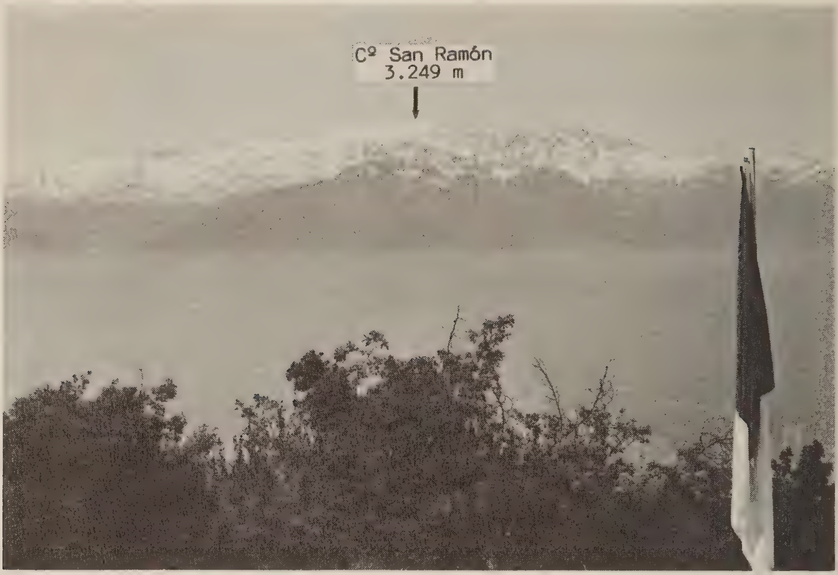


Fig. 4.- Vue E de la ville de Santiago couverte par le nuage de contaminants, depuis le Cerro San Cristóbal, 800 m (7-V-1987).

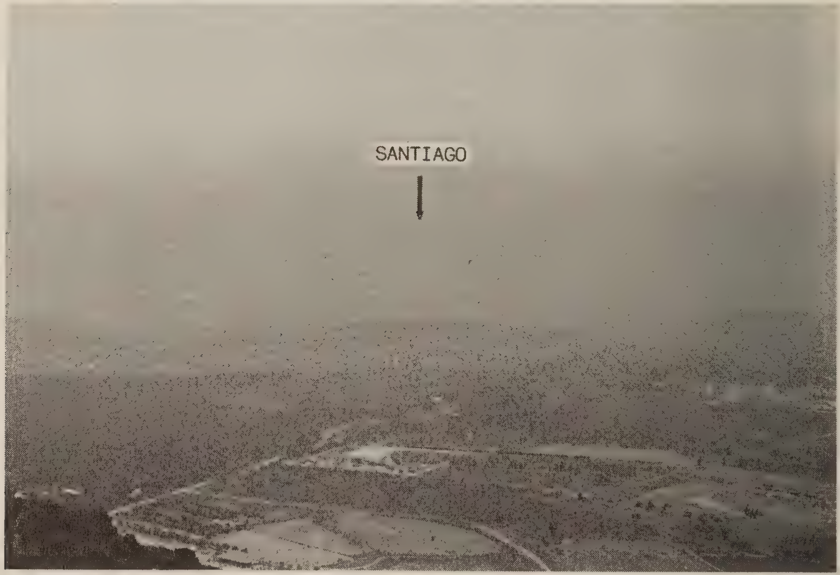


Fig. 5.- Vue de la ville de Santiago couverte par le nuage de contaminants, depuis les Cerros de San Carlos de Apoquindo, à l'Est de la ville, 970 m (6-XI-1987).

concentration au niveau tels qui dérangent ou détruisent la vie, la santé et le bienêtre humain, la flore et la faune ou dégradent la qualité de l'air, des biens, des recours nationales et particuliers".

SOURCES DE POLLUTION

Dans la ville de Santiago il y a environ 2.500 industries, 300.000 automoviles, 1.500 taxis et 4.000 autobus qui dépensent mensuellement 5.000 m3 d'essence. D'autre sources de la pollution la constituent la brûlure du bois, du charbon et du mazut pour la chauffage et la incinération des déchets ont fait que la pollution atmosphèrique dans la ville de Santiago soit alarmante. On voit clairement les effets de la pollution atmosphérique dans les feuilles d'arbres: la poussière sédimentaire qui couvre la lame foliaire (Fig. 6) fait disminuer ses activitées vitales et la tombée des feuilles (Fig. 7).

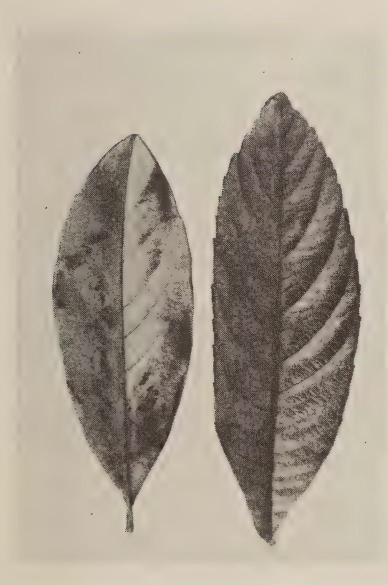


Fig. 6.- Feuilles de **Magnolia grandiflora** et de **Eriobotrya japonica** couvertes par la poussière sédimentaire. La moitie droite des lames sont propres.
Rue Diagonal Paraguay/Carmen

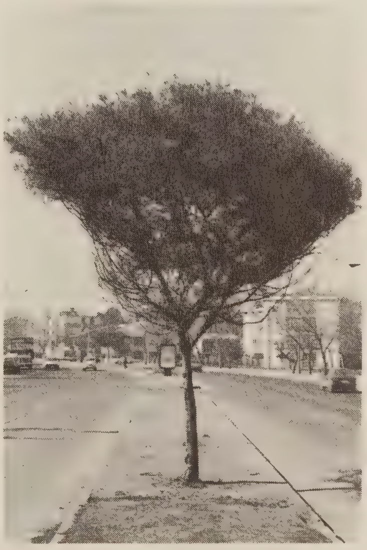


Fig. 7.- **Acacia retinodes** avec des branches inférieures defoliées à cause de la pollution atmosphérique.
Ave. Grecia 2976

MESURAGE DES CONTAMINANTS

Pour le mesurage des contaminants atmosphériques on a instalé quelques Stations dans la ville (Fig. 8). Les données obtenues sont representées dans les Fig. 9-13. L'enregistrement du Co a été effectué seulement dans la Station 1, les autres contaminants ont été enregistrés dans les différents Stations établies.

CONSTITUANTS DE LA POLLUTION ATMOSPHERIQUE

OXIDE D'AZOTE (NO2)

Les enregistrements ont été effectué avec un appareil semi-automatique de gazes RAC, Modèle PV. Pour l'analyse on emploie la méthode colorimétrique avec arsenite de sodium (NaAsO2), 24 heures du jour, deux fois par semaine, selon calendrier établi au commencement de l'année.

La Norme de Qualité de l'Air au Chili pour le NO2 est 100 ug/m3 (moyenne annuelle) ou, 300 ug/m3/24 heures (1 fois par an).

Dans la période 1977-1986, aucune Station a registrée, en moyenne, un excédent à la norme. La Station 2, situé dans l'aire centrale de Santiago, registrait l'indice le plus haut, 87 ug/m3 et les Stations 5 et 6 régistraient 76 et 69 ug/m3 respectivement. Les trois Stations se trouvaient dans les aires de haut flux véhiculaire. Les Stations 13 et 14 ont régistré les indices les plus bas avec 28 et 26 ug/m3, tous les deux sont loins du centre ville dans les aires de bas flux véhiculaire.

La norme a été dépassait plusieurs fois. La Station 2 en 1980 avec 112 ug/m3 et en 1981 avec 149 ug/m3, la Station 5 en 1981 avec 110 ug/m3, en 1985 avec 112 ug/m3 et en 1986 avec 116 ug/m3, et la Station 6 avec 132 ug/m3, en 1983 avec 111 ug/m3 et en 1986 avec 117 ug/m3. Les indices les plus hauts apparaisent pendant les mois d'Août et d'Octobre.

Source: Le NO2 provient principalement des industries et des véhicules à essence; Fig. 9.

MONOXIDE DE CARBONE (CO)

Les mesurages ont été effectué dans la Station 1, aire centrale de la ville, au moyen d'un Detector Ecolyzer (1977-1980) et un Detector Beckman, Modèle 866 (1981-1986). Le mesurage est faite pendant les 24 heures, tous le jours.

La Norme de Qualité de l'Air au Chili pour le CO est 35 ppm/1 heure (1 fois par an) ou, 9 ppm/8 heures (1 fois par an).

Dans les années 1979 et 1986 ont a registré, en moyen-

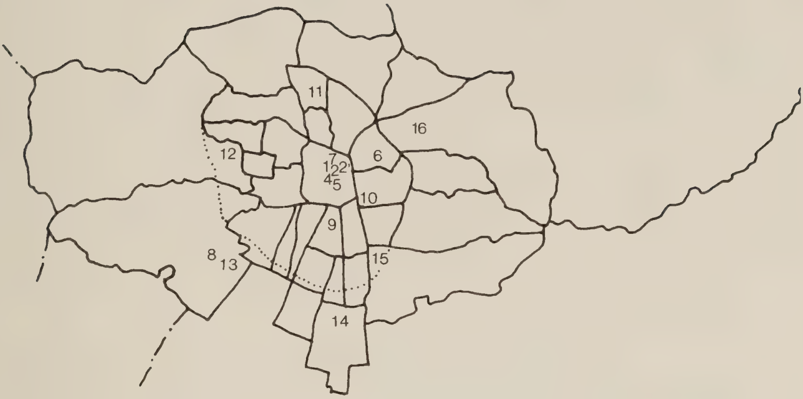


Fig. 8.- Réseau de Vigilance de Qualité de l'Air.
Distribution des Stations

STATION	COMUNE	DIRECTION	LIEU
1	Santiago	Agustinas/Estado	Iglesia San Agustín
2	Santiago	Santo Domingo 978	Comandancia de Bomberos
2'	Santiago	Mac Iver 541	Ministerio de Salud
4	Santiago	Santo Domingo 2398	Inst. de Salud Ocupacional
5	Santiago	Avda. Matta 576	7ª Cía. de Bomberos
6	Providencia	P. de Valdivia 963	I. Municipalidad de Providencia
7	Santiago	Independencia 939	Esc. Salud Pública
8	Maipú	5 de Abril 4936	Inst. Comercial Nº 7
9	San Miguel	Ismael Valdés 2020	3ª Cía. de Bomberos
10	Ñuñoa	Marathon 1000	Inst. de Salud Pública
11	Conchalí	Independencia 3450	1ª Cía de Bomberos
12	Pudahuel	Teniente Cruz 1087	Consultorio Carlos Avendaño
13	Maipú	Avda. Cerrillos 674	2ª Cía. de Bomberos
14	La Granja	La Pintana	Cooperativa José Maza
15	La Florida	Vic. Mackenna 7196	9ª Cía. de Bomberos
16	Las Condes	Las Condes/Las Clarisas	20ª Cía. de Bomberos

ne 35.6 et 36.4 ppm/1 heure, respectivement. Les indices dans les autres années étaient inférieures à la norme. En 1978 on a registré 14 ppm/1 heure, le plus bas, en 1983 et en 1984 moins que 20 ppm/1 heure.

Les variations horaires du CO sont associées au flux véhiculaire et aux conditions climatiques. En hiver, le CO se présente en plus grande quantité dû à sa moindre diffusion dans l'atmosphère.

Ce contaminant constitue un des plus grands risques sanitaires par tout le monde.

Source: Le CO provient spécialement des véhicules à essence; Fig. 10.

ANHYDRIDE SULPHUREUX (SO2)

La mesurage a été effectué avec un appareil semi-automatique de gazes RAC, Modèle PV. Dans l'analyse on emploie la méthode colorimétrique de la p-roseaniline. L'echantillonage est permanent dans les 24 heures, deux fois par semaine, selon calendrier établi au commencement de l'année.

La Norme de Qualité de l'Air au Chili pour le SO2 est 80 ug/m3 (moyenne annuelle) ou, 365 ug/m3 pour 24 heures (1 fois par an).

Dans la période 1977-1986 on ne registre pas des valeurs, moyenne annuelles, sur la norme. La Station 2 registrait 51 ug/m3, l'indice le plus haut, correspondant à l'aire centrale de la ville. Les Stations 2, 5, 6 et 10 registraient indices entre 35 et 42 ug/m3 dans des secteurs de haut flux véhiculaire et probablement avec des bâtiments au chauffage à mazut. Les indices les plus hauts se registrent en hiver.

Source: Combustion de mazut provenant des chauffages, quelques véhicules et fours; Fig. 11.

POUSSIERE EN SUSPENSION

L'obtention de la poussière en suspension est effectué avec l'instrument High Volume, RAC, Modèle GMW-2000. Les échantillons sont analysés gravimétriquement. L'obtention est continue pendant les 24 heures, deux fois par semaine, selon calendrier établi au commencement de l'année.

La Norme de Qualité de l'Air au Chili pour la Poussière en Suspension est de 260 ug/m3 (moyenne annuelle) pour 24 heures (1 fois par an) ou, 75 ug/m3 moyenne geométrique annuelle.

Les Stations 2, 11 et 12 ont dépassé la norme avec une moyenne pour la période 1977-1986, de 330, 290 et 320 ug/m3 respectivement. La Station 2 est situé dans l'aire centrale de la ville où il y a un haut flux véhiculaire. Les Stations 11 et 12 sont loin du centre ville et proche aux espaces ouvertes et aux centres minières exposés à l'action eólique. Les Stations 2' et 6 sont dans des aires de haut flux véhiculaire et la Station 13 proche aux aires inhabitées et à l'action eólique.

Source: Activités industrielles, de la constrution, l'usage des pneumatiques, mouvement des autobus et des camions; Fig. 12.

POUSSIERE SEDIMENTAIRE

Pour l'echantillonage de la poussière sédimentaire on utilise un depôt de materiel polimérique de 14 cm de lumière et 40 cm de haut par des périodes de 30 jours. Le depôt, auquel on a mis de la protection contre les oiseaux, est exposé à 3 m hauteur. La poussière sédimentée est extraite du cylindre avec de l'eau distilée et avec de l'eau démineralisée. Les paticules sont separés au moyen du papier filtre, san insectes ou des morceaux des plantes ou d'autres matières. Le papier filtre est analysé par fluorescence des rayons X dans un spectrométre EDAX/PHILIPS.

La Norme de Qualité de l'Air recommendée par le WHO, adoptée au Chili pour la Poussière Sédimentaire est 0.5 ug/cm2/30 jours (moyenne annuelle).

Dans les Stations 8, 9, 10, 11, 12 et 15, la moyenne dans la période 1977-1986, la poussière sédimentaire depassait la norme. La Station 12 registrait une moyenne de 0.85 ug/cm2, l'indice le plus haut. La plus petite quantité de poussière sédimentaire fût registrée dans les Stations 4 et 6 avec 0.4 ug/cm2. Les indices les plus hauts se trouvent dans les mois d'Octobre à Mars, les mois moins pluvieux.

Source: Activités industrielles, combustion de dispositif domestiques, activités de la construction, activités minières, mouvement des autobus et camions et le vent qui transportent la poussière; Fig. 13.

DIVISION GEOGRAPHIQUE DE LA PROV. DE SANTIAGO

La Province de Santiago a une surface de 2.000 km2 et une population de 3.672.374 habitants. Géographiquement, à été divisé en 32 comunes, dans 11 desquelles on a récoltée des lichens (Fig. 14), dans les autres comunes fût impossible effectuer des récoltes lichéniques.

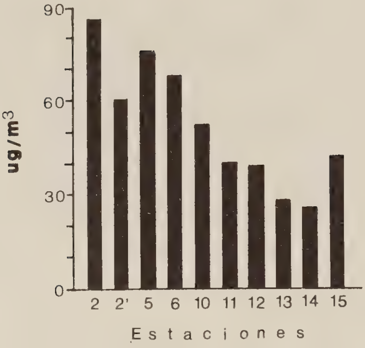


Fig. 9.- Concentration moyenne annuelle de Oxide de Nitrogène, selon Station. Période 1977-1986

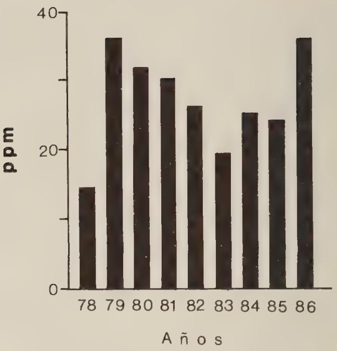


Fig. 10.- Concentration maxime de Monoxide de Carbone par heure, moyenne annuelle, dans le Station 1. Période 1978-1986

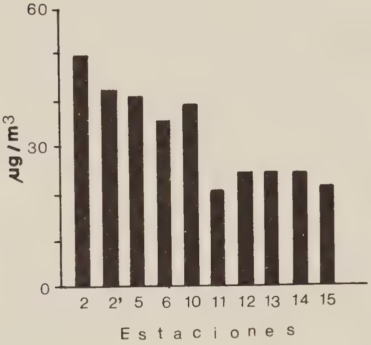


Fig. 11.- Concentration moyenne annuelle de Anhydride Sulphureux, selon Station. Période 1977-1986

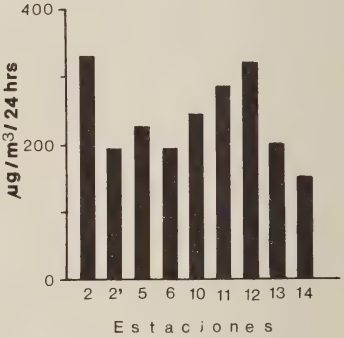


Fig. 12.- Concentration moyenne annuelle de Poussière en Suspension, selón Station. Période 1978-1986

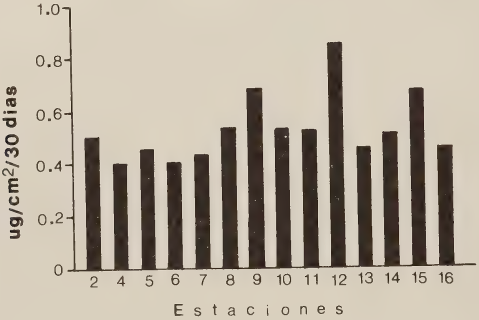


Fig. 13.- Poussière Sédimentaire selon Station. Période 1977-1986

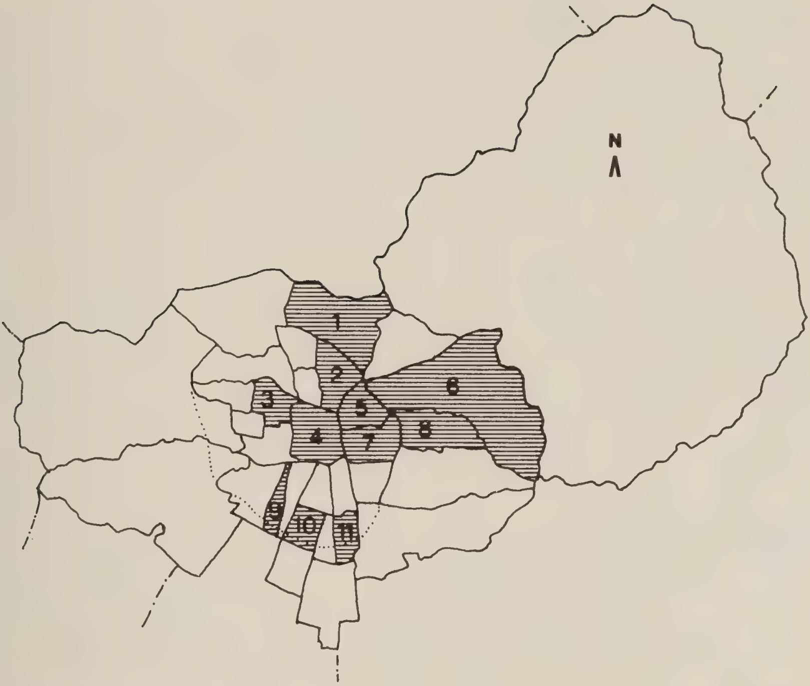


Fig. 14.- Province de Santiago. Les lichens fûrent récoltées dans les comunes hachées: 1.- Comuna de Huechuraba; 2.- Comuna de Recoleta; 3.- Comuna de Quinta Normal; 4.- Comuna de Santiago; 5.- Comuna de Providencia; 6.- Comuna de Las Condes; 7.- Comuna de Ñuñoa; 8.- Comuna de La Reina; 9.- Comuna de Lo Espejo; 10.- Comuna de La Cisterna; 11.- Comuna de La Granja.

DISTRIBUTION DES LICHENS DANS LES DIFFERENTES COMUNES ETUDIEES

BUELLIA FUSCULA (NYL.) ZAHLBR.

COMUNA DE HUECHURABA: Ave. Circunvalación Américo Vespucio, sur l'écorce de **Robinia**, 1984. COMUNA DE RECOLETA: Estadio Recoleta, sur l'écorce de **Robinia**, 1984. COMUNA DE LA GRANJA: La Castrina, sur un poteau en **Nothofagus**, 1967; Fig. 15a.

CALOPLACA CERINA (EHRH. ex HEDW.) TH. FR.

COMUNA DE HUECHURABA: Ave. Circunvalación Américo Vespucio, sur l'écorce de **Robinia**, 1984. COMUNA DE LA CISTERNA: Gran Avenida, Paradero 28 1/2, sur un poteau en

Nothofagus, 1968; Fig. 15b.

CANDELARIELLA VITELLINA (HOFFM.) MULL.- ARG.

COMUNA DE HUECHURABA: Ave. Circunvalación Américo Vespucio, sur l'écorce de **Robinia**, 1984. COMUNA DE LA CISTERNA: Gran Avenida, Paradero 28 1/2, sur un poteau en **Nothofagus**, 1968; Fig. 15c.

GASPARRINIA MICROPHYLLA (HUE) DODGE

COMUNA DE HUECHURABA: Ave. Circunvalación Américo Vespucio, sur l'écorce de **Robinia**, 1984. COMUNA DE RECOLETA: Estadio Recoleta, sur l'écorce de **Robinia**, 1984. COMUNA DE QUINTA NORMAL: Quinta Normal, sur l'écorce de **Platanus**, 1984. COMUNA DE SANTIAGO: Cerro San Cristóbal, Plaza Gabriela Mistral, sur l'écorce de **Robinia**, 1987; Rue Nataniel 1777, sur l'écorce de **Robinia**, 1984; Plaza de Armas, sur l'écorce d'**Acacia**, 1985; Plaza Brasil, sur l'écorce de **Gymnocladus**, 1984; Parque O"HIggins, sur l'écorce de **Fraxinus**, 1987; Parque Forestal, Ave. Cardenal Caro/Puente Loreto, sur l'écorce de **Platanus**, 1984. COMUNA DE PROVIDENCIA: Rue Clemente Fabres 1040, sur une colonie de **Tortula**, 1984. COMUNA DE LAS CONDES: Rue Tomás Moro 261, sur l'écorce de **Prunus**, 1985; Rue San Pascual 59, sur l'écorce d'**Ulmus**, 1984. COMUNA DE ÑUÑOA: Rue Las Dalias/Exequiel Fernández, sur l'écorce de **Robinia**, 1984; Rue Las Palmeras 3395, sur l'écorce d'**Acer**, 1987; Rue Los Alerces 2726, sur l'écorce d'**Acer**, 1984. COMUNA DE LA REINA: Rue Julia Berstein s/n, sur l'écorce de **Robinia**, 1984; Rue Alvaro Casanova s/n, sur l'écorce de **Robinia**, 1986. COMUNA DE LO ESPEJO: Rue Colón 70, sur l'écorce de **Robinia**, 1986. COMUNA DE LA CISTERNA: Gran Avenida, Paradero 28 1/2, sur un poteau en **Nothofagus**, 1968; Rue 21 de Mayo 070A, sur l'écorce de **Prunus**, 1986; Fig. 15d.

LECANIA CHILENA DODGE

COMUNA DE LA CISTERNA: Gran Avenida, Paradero 28 1/2, sur un mur en mortier, 1967; Fig. 15e.

LECANORA DISPERSA (PERS.) SOMMERF.

COMUNA DE HUECHURABA: Ave. Circunvalación Américo Vespucio, sur l'écorce de **Robinia**, 1984. COMUNA DE QUINTA NORMAL: Quinta Normal, sur l'écorce de **Platanus**, 1984; Ibid., sur l'écorce de **Magnolia**, 1984; Ibid., sur l'écorce de **Grevillea**, 1984; Ibid., Hospital J.A.Ríos, sur un mur en mortier, 1984; Municipalidad de Quinta Normal, Parque

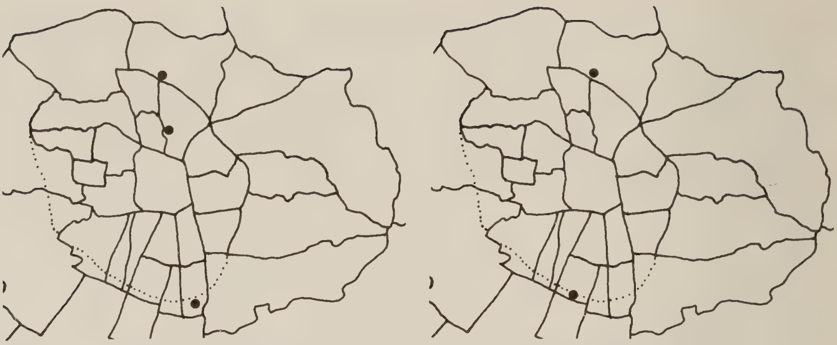
Lo Franco, sur l'écorce d'**Araucaria**, 1984. COMUNA DE SATIAGO: Parque O"Higgins, sur l'écorce d'**Ulmus**, 1987; Ibid., sur l'écorce de **Ligustrum**, 1987; Ibid., sur le stipe de **Washingtonia**, 1987; Ibid., sur l'écorce de **Fraxinus**, 1987; Ibid., sur l'écorce de **Robinia**, 1987; Ibid., sur l'écorce de **Cryptocarya**, 1987; Ibid., sur l'écorce de **Schinus**, 1987; Ave. Ricardo Cumming 350, sur l'écorce d'**Erythrina**, 1984; Parque Forestal, Ave. Cardenal Caro/Puente Loreto, sur l'écorce de **Platanus**, 1984; Ibid., au coté Nord du Museo de Bellas Artes, sur des racines de **Washingtonia**, 1984; Cerro Santa Lucía, sur un mur en mortier, 1968; Plaza Hermanos Matte, sur l'écorce de **Robinia**, 1984; Plaza de Armas, sur l'écorce d'**Acacia**, 1985; Plaza Brasil, sur l'écorce d'**Erythrina**, 1984; Ibid., sur le stipe de **Phoenix**, 1984; Ibid., sur l'écorce de **Populus**, 1984; Plaza Santa Lucía, sur l'écorce de **Cedrus**, 1984; Parque Bustamante 1001, sur l'écorce d'**Ulmus**, 1988; Ave. Matta 336, sur l'écorce d'**Ulmus**, 1988. COMUNA DE PROVIDENCIA: Plaza Guillermo Frencke, sur l'écorce d'**Acacia**, 1987; Rue Román Díaz 1935, sur l'écorce de **Platanus**, 1984. COMUNA DE LAS CONDES: Rue San Pascual 59, sur l'écorce d'**Ulmus**, 1984. COMUNA DE ÑUÑOA: Rue Palqui 2990, sur un mur en mortier, 1984; Rue Dr. Johow/Ave. Grecia, sur des branches d'**Acer**, 1984; Rue Exequiel Fernández/Los Alerces, sur des branches d'**Acer**, 1984; Rue Las Palmeras 3395, sur l'écorce d'**Acer**, 1987; Rue Virginio Arias 1350, sur un mur en mortier, 1984; Rue Pedro Torres 775, sur des branches d'**Acer**, 1984; Rue Las Dalias 1809, sur l'écorce de **Robinia**, 1984; Rue Los Jardines 207, sur l'écorce de **Citrus**, 1988; Fig. 15f.

LEMPHOLEMMA SP.

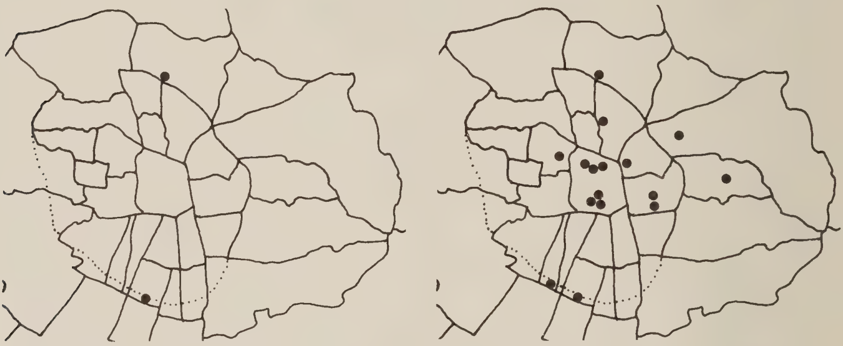
COMUNA DE HUECHURABA: Ave. Circunvalación Américo Vespucio, sur l'écorce de **Robinia**, 1984. COMUNA DE SANTIAGO: Cerro Santa Lucía, sur un mur en mortier, 1984. COMUNA DE ÑUÑOA: Rue Virginio Arias 1350, sur un mur en mortier, 1984; Ibid., 1308, sur l'écorce d'**Acer**, 1988. COMUNA DE LA CISTERNA: Gran Avenida, Paradero 28 1/2, sur un poteau en **Nothofagus**, 1968; Fig. 16a.

PARMELIA SP.

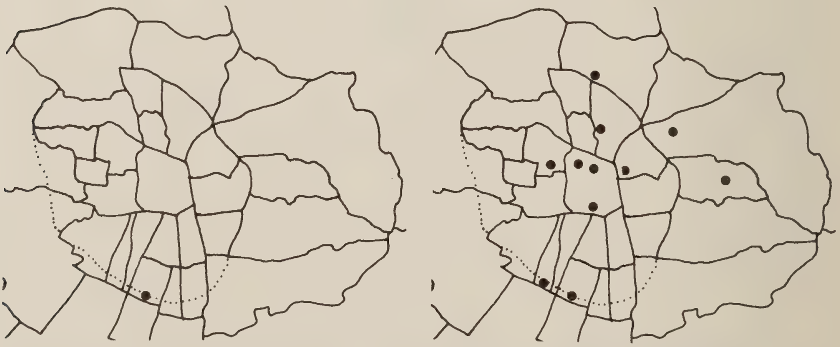
COMUNA DE RECOLETA: Estadio Recoleta, sur l'écorce de **Robinia**, 1984. COMUNA DE SANTIAGO: Parque Forestal, Ave. Cardenal Caro/Puente Loreto, sur l'écorce de **Platanus**, 1984 Cerro San Cristóbal, sur l'écorce de **Robinia**, 1987. COMUNA DE ÑUÑOA: Rue Las Palmeras 3395, sur l'écorce d'**Acer**, 1987. COMUNA DE LA REINA: Rue Alvaro Casanova s/n, sur l'écorce



a) Buellia fuscula b) Caloplaca cerina



c) Candelariella vitellina d) Gasparrinia microphylla



e) Lecania chilena f) Lecanora dispersa

Fig. 15a-f.- Distribution des espèces lichéniques dans les différentes comunes de la ville de Santiago. Les points noirs indiquent les endroits de récolte de chaque espèce.

de **Robinia**, 1984; Fig. 16b.

PHYSCIA ADSCENDENS (TH. FR.) OLIV. emend. BITT.

COMUNA DE HUECHURABA: Ave. Circunvalación Américo Vespucio, sur l'écorce de **Robinia**, 1984. COMUNA DE RECOLETA: Estadio Recoleta, sur des branches de **Robinia**, 1984. COMUNA DE QUINTA NORMAL: Quinta Normal, sur l'écorce de **Platanus**, 1984. COMUNA DE SANTIAGO: Plaza Brasil, sur l'écorce de **Gymnocladus**, 1984; Plaza de Armas, sur l'écorce d'**Acacia**, 1985. Parque Forestal, Ave. Cardenal Caro/Puente Loreto, sur l'écorce de **Platanus**, 1984; Parque O"Higgins, sur l'écorce de **Fraxinus**, 1987; Ave. Viel 1462, sur des branches de **Vitis**, 1967. COMUNA DE ÑUÑOA: Rue Dr. Johow/Ave. Grecia, sur des branches d'**Acer**, 1984; Rue Las Dalias/Los Alerces, sur l'écorce de **Robinia**, 1984; Rue Pedro Torres 775, sur l'écorce d'**Acer**, 1984; Rue Las Palmeras 3395, sur l'écorce d'**Acer**, 1987. COMUNA DE LA REINA: Rue Alvaro Casanova s/n, sur l'écorce de **Robinia**, 1984. COMUNA DE LO ESPEJO: Rue Colón 70, sur l'écorce de **Robinia**, 1985. COMUNA DE LA CISTERNA: Gran Avenida, Paradero 28 1/2, sur un poteau en **Nothofagus**, 1967; Rue 21 de Mayo 070A, sur l'écorce de **Prunus**, 1986; Fig. 16c.

RAMALINA ECKLONII (SPRENG.) MEY. et FLOT.

COMUNA DE RECOLETA: Estadio Recoleta, sur l'écorce de **Robinia**, 1984. COMUNA DE LA REINA: Rue Alvaro Casanova s/n, sur l'écorce de **Robinia**, 1984. COMUNA DE LA CISTERNA: Gran Avenida, Paradero 28 1/2, sur un poteau en **Nothofagus**, 1968; Fig. 16d.

TELOSCHISTES CHRYSOPHTHALMUS (L.) Th. FR.

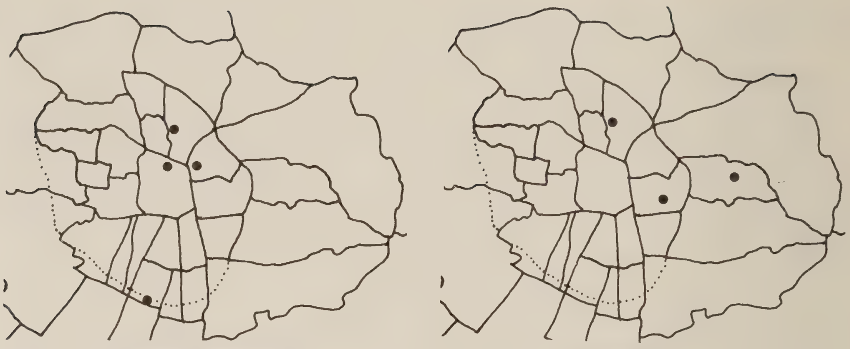
COMUNA DE LA REINA: Rue Alvaro Casanova s/n, sur l'écorce de **Robinia**, 1984; Fig. 16e.

USNEA IGNIARIA MOT.

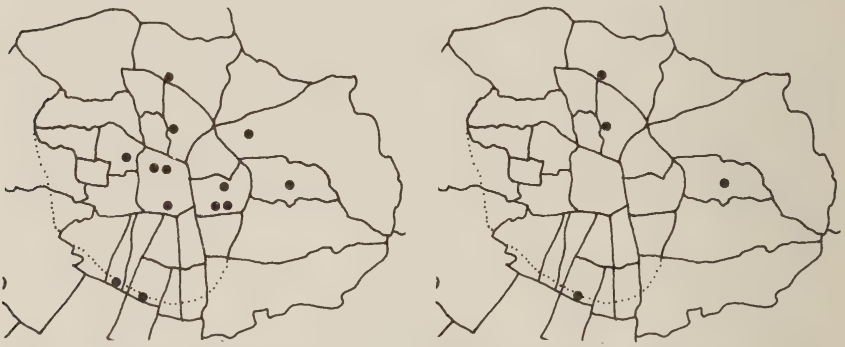
COMUNA DE LA REINA: Rue Alvaro Casanova s/n, sur l'écorce de **Robinia**, 1984; Fig. 16f.

XANTHORIA PARIETINA (L.) TH. FR.

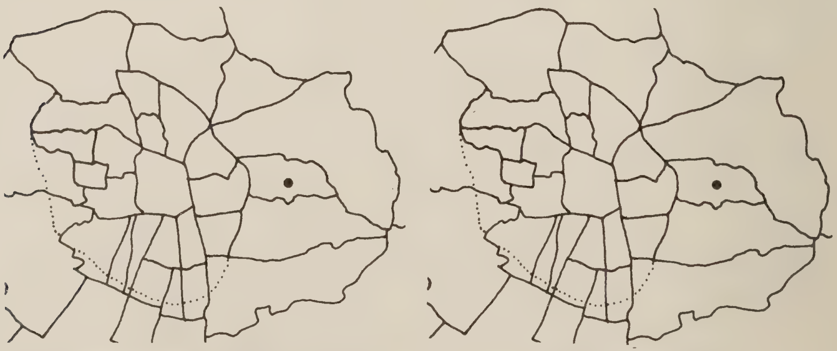
COMUNA DE SANTIAGO: Cerro San Cristóbal, Plaza Gabriela Mistral, sur l'écorce de **Robinia**, 1986. COMUNA DE ÑUÑOA: Rue Las Palmeras 3395, sur l'écorce d'**Acer**, 1987. COMUNA DE LA REINA: Rue Alvaro Casanova s/n, sur l'écorce de **Robinia**, 1984; Fig. 17a.



a) Lempholemma sp. b) Parmelia sp.



c) Physcia adscendens d) Ramalina ecklonii

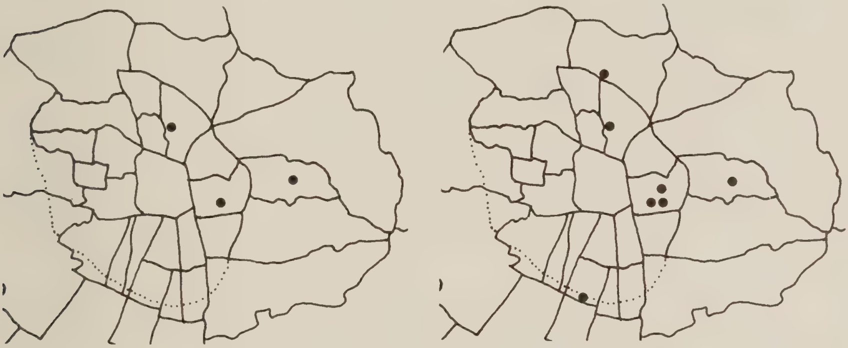


e) Teloschistes chrysophthalmus f) Usnea igniaria

Fig. 16a-f.- Distribution des espèces lichéniques dans les différentes comunes de la ville de Santiago. Les points noirs indiquent les endroits de récolte de chaque espèce.

XANTHORIA POLYCARPA (HOFFM.) OLIV.

COMUNA DE HUECHURABA: Ave. Circunvalación Américo Vespucio, sur l'écorce de **Robinia**, 1984. COMUNA DE RECOLETA: Estadio Recoleta, sur l'écorce de **Robinia**, 1984. COMUNA DE ÑUÑOA: Rue Rodrigo de Araya/Exequiel Fernández, sur l'écorce de **Prunus**, 1972; Rue Dr. Johow/Ave. Grecia, sur l'écorce d'**Acer**, 1984; Rue Pedro Torres 775, sur l'écorce d'**Acer**, 1984. COMUNA DE LA REINA: Rue Alvaro Casanova s/n, sur l'écorce de **Robinia**, 1984. COMUNA DE LA CISTERNA: Rue 21 de Mayo 070A, sur l'écorce de **Prunus**, 1986; Fig. 17b.



a) Xanthoria parietina b) Xanthoria polycarpa

Fig. 17a-b.- Distribution des espèces licheniques dans les différentes comunes de la ville de Santiago. Les points noirs indiquent les endroits de récolte de chaque espèce.

Un résumé de la distribution des lichens et ses phorophytes est exposé dans le Schème 1.

D'APRES LA POLLUTION ET LA DISTRIBUTION DES LICHENS RECOLTEES DANS LA VILLE DE SANTIAGO, ON OBSERVE QUE:

1.- Comme conséquence de la situation géographique de la ville de Santiago, dans une dépression entourée par des cordons montagneux hauts, les contaminants restent retenus d'une manière permanente sur la ville. L'effet du vent est inefficace pour transporter la pollution à d'autres endroits.

2.- Les contaminants mesurés sont, en général, moindres que la norme. La poussière en suspension et la poussière sédimentaire dépassait la norme, en moyenne, dans 3 et 6 endroits respectivement.

PHOROPHYTES LICHENS	Acacia caven	Acer negundo	Acer pseudoplatanus	Araucaria angustifolia	Cedrus deodara	Citrus sinensis	Cryptocarya alba	Erythrina crista-galli	Fraxinus americana	Grevillea robusta	Gymnocladus dioica	Ligustrum lucidum	Magnolia grandiflora	Phoenix canariensis	Platanus orientalis	Populus nigra	Prunus armeniaca	Prunus avium	Robinia pseudo-acacia	Schinus molle	Ulmus americana	Vitis vinifera	Washingtonia filifera	Washingtonia robusta	Tortula muralis	Madère de Nothofagus	Mortier
1.- Buellia fuscula																			+							+	
2.- Caloplaca cerina																			+							+	
3.- Candelariella vitellina																			+							+	
4.- Gasparrinia microphylla	+								+		+				+		+	+	+		+				+	+	
5.- Lecania chilena																											+
6.- Lecanora dispersa	+	+		+	+	+	+	+		+		+	+	+	+	+			+	+	+		+	+			+
7.- Lempholemma sp.			+																+							+	+
8.- Parmelia sp.		+													+				+								
9.- Physcia adscendens	+	+							+		+				+			+	+			+				+	
10.- Ramalina ecklonii																			+							+	
11.- Teloschistes chrysophth.																			+								
12.- Usnea igniaria																			+								
13.- Xanthoria parietina		+																	+								
14.- Xanthoria polycarpa		+															+	+	+								
Lichens par phorophytes	3	5	1	1	1	1	1	1	2	1	2	1	1	1	4	1	2	3	13	1	2	1	1	1	1	7	3

Schème 1.- Lichens récoltés dans les différentes comunes et son substratum respectif.

3.- **Buellia fuscula**, **Caloplaca cerina**, **Candelariella vitelina**, **Lecania chilena**, **Teloschistes chrysophthalmus** et **Usnea igniaria**, etaient dans des aires éloignées du centre ville, qui est l'aire avec la plus intense pollution.

4.- **Gasparrinia microphylla**, **Lecanora dispersa** et **Physcia adscendens**, sont les espèces les plus répandues dans la ville.

5.- Des 14 espèces observées, 9 se trouvent dans la Comune de La Reina, vers le limit suburbain à 260 m plus haut que les plus grand des autres altitudes régistrées. C'est un endroit avec une atmosphère plus propre et plus humide.

6.- Dans l'écorce de **Robinia pseudo-acacia**, on a trouvé 13 des 14 espèces licheniques récoltées (92.9%) et 3 espèces sont trouvées, chacune, dans un seule type de substratum.

7.- Dans toutes les comunes revisées on a trouvé des lichens.

8.- La polltuion atmosphérique de l'aire centrale de la ville n'empêche pas l'accroisement des lichens. Les thalles de **Gasparrinia microphylla** récoltées dans la Plaza de Armas (centre ville) se présentent granuleuses et presque détruites.

REMERCIEMENTS

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STUDIES ON XYLOPHILOUS FUNGI FROM ARGENTINA. IV. ANAMORPHS OF BASIDIOMYCETES ON EUCALYPTUS VIMINALIS (MYRTACEAE)*

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ABSTRACT

Eight anamorphs of lignicolous Basidiomycetes are described. Among them three new genera: **Fibulochlamys**, **Corticomyces** and **Glomerulomyces** are proposed with their respective species: **F. ferruginosa**, **C. xenasmatoides** and **G. fibulosus**. One new species: **Allescheriella cyanea** is proposed. **Haplotrichum curtisii**, **H. gracile** and **Sporotrichum aurantiacum** are first records for Argentina. The position of **"Sporotrichum" azureum** is open to discussion.

INTRODUCTION

During an ecological and systematic survey of fungal communities on standing trees, logs and stumps of **Eucalyptus viminalis** Labill. in the province of Buenos Aires (Lopez, 1983; Romero, 1983; Lopez, 1984; Lopez & Wright, 1985) a number of anamorph samples were collected which revealed either the presence of clamp-connections on the vegetative or conidiogenous hyphae, or a close affinity with Basidiomycetes as recorded in the literature.

In spite of the increasing interest showed in the last years on the mitospores in Basidiomycetes (Kendrick & Watling, 1979; Stalpers, 1984; Buchalo et al., 1985) most workers are basidiomycetologists more interested with the teleomorph than the anamorph, describing it poorly. Nevertheless, the number of new basidiomycetous anamorphs increases year by year (Nag Raj, 1978; Dyko & Sutton, 1979; Sivanesan & Watling, 1980; Gochenaur, 1981; Wright, 1983; Stalpers & Vlug, 1983; Pantidou et al., 1983; Udagawa et al., 1986) resulting in the need of descriptions on the basis of modern conidiogenic concepts and recognition of the generic and specific anamorphic taxa in order to allow an orderly systematic disposition of those forms which may lead to a better understanding of the group as a whole.

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DESCRIPTIONS OF THE TAXA

1. **Fibulochlamys** Romero & Cabral, gen. nov.

Hyphis hyalinis, fibulatis. Conidiophoriis absentibus vel micronematosis, simplicibus vel rarae ramosis. Cellulis conidiogenis cylindricis, terminalibus vel subinde intercalaribus, hyalinis, fere semper in fibula basali consociatis. Conidiis holothallici, globosis vel ellipsoideis vel pyriformibus, aseptatis, pallide flavis, laevibus crassissime tunicatis, umbonatis, interdum pedicellatis.

Species typica: **Fibulochlamys ferruginosa** Romero & Cabral

Etymology: **Fibula**, Latin for clamps; **Chlamys**, Greek for "mantle" enveloping conidia.

Hyphae hyaline, with clamps. Conidiophora absent or micronematous simple or seldom branched. Conidiogenous cells cylindric, terminal or intercalary, hyaline, almost always associated with a basal clamp. Conidia holotallic, globose ellipsoidal or pyriform, sometimes pedicellate, 0-septate, pale yellow, very thick-walled.

Type species: **Fibulochlamys ferruginosa** Romero & Cabral

1.a. **Fibulochlamys ferruginosa** Romero & Cabral, sp. nov.(Fig. 1: A-C)

Coloniae ad corticem et lignun 2-3 cm in longitudine, resupinatae, adpressae, aspectu crystallino sub lente, in sicco ferrugineo pallido. Mycelio hyalino, fibulato, hyphis cylindricis, 3-4 um diam. et hyphis e cellulis brevibus et irregularibus composito. Conidiophoriis absentibus vel micronematosis, simplicibus vel rarae ramosis. Cellulis conidiogenis cilindricis, terminalibus vel rarae intercalaribus, fere semper consociatis in fibula basali. Conidibus holothallicis, pallide flavis, globosis, 12-18 um diam, ellipsoideis, 10-12 x 20-23 um, vel globosis pedicellatis, umbonatis, aseptatis, continentibus granulosis cum 2-3 gutulae, dextrinoidae.

HOLOTYPUS: Argentina, Buenos Aires, Ramallo; leg.: Romero, Cabral & Lopez, VIII-1982, ad partem amputatam trunci **Eucalypti viminalis**, in Herb. BAFC N° 30826 conservatum est.

Etymology: **ferruginosus** Latin for the rusty colour of the colonies

Teleomorph: unknown

Conidiomata on bark and wood, 2-3 cm in length, resupinate, tight, like crystals of sugar under a lens, light ferrugineous when dry (M & P, Pl.12, 10 K, "Chinese Gold"). Hyphae hyaline, with clams present at all prymary septa, composed of cylindric hyphae 3 um diam and irregular hyphae consisting of short cells. Conidiophores absent or micronematous, not branched or rarely so. Conidiogenous cells cylindric, terminal, generally associated with a basal clamp, or intercalary. Conidia holotallic, light yellow, globose, 12-18 um diam, pyriform or ellipsoidal, 10-12 x 20-23 um or sometimes pedicellate, often with an umbo at both end as a result of a subapical widening of the conidiogenous cell, 0-septate, thick-walled, wall 2-3 um thick when mature, dextrinoid, with 1-3 oildrops.

Material studied: the holotype.

Remarks: Despite a number of Basidiomycetes having "chlamydospore" type of conidia related with the basidiocarp or described in culture, it is rare to find only chlamydospores in nature, without any associated basidiocarp. Because no teleomorph was detected in this material, we think it is necessary to describe as an independent new form-genus.

With the date available we are not be able to state if **Fibulochlamys** is the anamorph of other Basidiomycetes with chlamydospore-like structures but this should be a subject of further studies.

This specimen has been illustrated and described by Lopez (1984) who included it in the **Allescheriella** type, according to Kendrick & Watling (1979). But on account of its holothallic ontogeny, we consider it a new genus.

On the other hand, it is closely related to the genus **Pagidospora** Drechsler, but it differs because of the lack of the trapping structures which is the main characteristic of this genus (Drechsler,1960).

2. **Corticomyces** Romero & Lopez, gen. nov.

Hyphis hyalinis, fibulatis, paucis. Conidiophoriis absentibus. Cellulis conidiogenis blasticis, cylindricis vel indistinctis. Conidiis holoblasticis, rhexolyticis, ellipsoidis, hyalinis, aseptatis, tenuitunicatis, laevibus.

Species typica: **Corticomyces xenasmatoides** Romero & Lopez.

Etymology: **Cortex** Latin for bark; **myces** Greek for fungus.

Hyphae hyaline, with clamps, scanty. Conidiophores absent. Conidiogenous cells blastic, cylindric or undifferentiated from the vegetative cells. Conidia holoblastic, rhexolytic secession, ellipsoidal, hyaline, 0-septate, thin-walled, smooth.

Type species: **Corticomyces xenasmatoides** Romero & Lopez

2.a. **Corticomyces xenasmatoides** Romero & Lopez, sp. nov. (Fig.1: D-F)

Coloniae ad corticem et lignum, resupinatae, araneosae et pruinosae, aspectu xenasmatoide, albae vel griseae. Mycelio inconspicuo, e hyphis tenuis, 0.5-1.5 um diam, fibulatis, paucis composito. Conidiophoriis absentibus. Cellulis conidiogenis blasticis, cylindricis vel indistinctis, 10-20 um longitudine. Conidiis holoblasticis, rhexolyticis, ellipsoideis, hyalinis, aseptatis, tenuitertunicatis, laevibus, interdum guttulatis, 6-9 x 4-7 um.

HOLOTYPUS: Argentina, Buenos Aires, Gobernador Castro, leg.: Romero, Cabral & Lopez, V-1983, ad partem amputatam trunci **Eucalyptus viminalis**, in Herb. BAFC Nº 30827 conservatus est.

Etymology: **xenasmatoides** Latin for resembling the basidiocarp of the genus **Xenasma**.

Teleomorph: unknown.

Conidiomata on bark and wood, resupinate, effuse, arachnoid and pruinose, with xenasmatoid aspect, greyish white. Mycelium scanty, hyphae thin, 0.5-1.5 um diam, with clamps. Conidiophores absent. Conidiogenous cells blastic, cylindrical or undifferentiated from the vegetative cells, 10-20 um long. Conidia holoblastic, rhexolytic secession, ellipsoidal,hyaline, 0-septate, thin-walled, smooth, 6-9 x 4-7 um, sometimes guttulate, always terminal.

Material studied: the holotype. Argentina, Buenos Aires, Gobernador Castro, leg.: Romero, Cabral & Lopez, II-1982 (BAFC Nº 30828); ibid, Ramallo, V-1982 (BAFC Nº 31272).

Remarks: it grows on ME with similar characteristics as in nature.

One could find some similarities between **Corticomyces** conidia and the chlamydospores produced in culture by some Basidiomycetes.However, such conidia do not have the typical chlamydospore wall and cytoplasmatic content to be considered a resting spore.

3. Glomerulomyces Romero & Lopez, gen nov.

Hyphis hyalinis, fibulatis. Conidiophoriis semimacronematosiis, simplicibus vel ramosis, fibulatis. Cellulis conidiogenis mono-polyblasticis, ellipsoideis, terminalibus, hyalinis. Conidiis holoblasticis, globosis, hialinis, aseptatis, tenuitertunicatis, laevibus gemmiferis, in capituliis globosis compactis.

Species typica: **Glomerulomyces fibulosus** Romero & Lopez

Etymology: **Glomerulus** Latin for the clusters of conidia into a head; **myces** Greek for fungus.

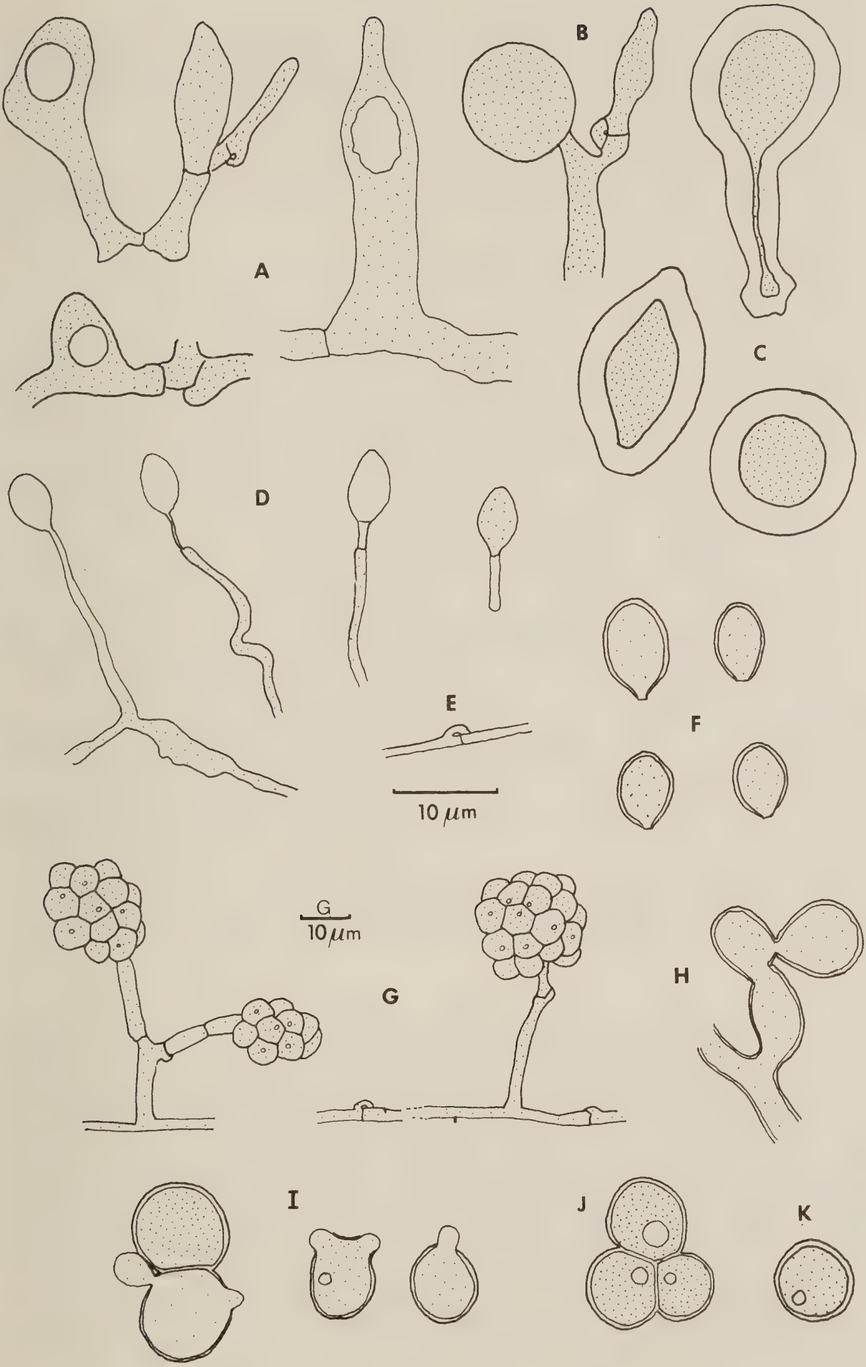
Hyphae hyaline, with clamps. Conidiophores semimacronematous, simple or branched, with clamps. Conidiogenous cells mono-polyblastic, ellipsoidal, terminal, hyaline. Conidia holoblastic, spherical, hyaline, aseptate, smooth, budding, in globose compact heads, thin-walled,

Type species: **Glomerulomyces fibulosus** Romero & Lopez

3.a. Glomerulomyces fibulosus Romero & Lopez, sp. nov.(Fig. 1: G-K)

Coloniae ad corticem et lignum, effusae, pelliculosae, farinaceae, albae calcareae vel cremeae. Mycelio hyalino, fibulato, hyphis 2.5-5

FIGURE 1 : A-C : **Fibulochlamys ferruginosa.** A: Conidiogenous cell in different stages of development. B: Conidiophores with a young conidium. C: Conidia. D-F: **Corticomyces xenasmatoides.** D: Conidiogenous cells. E: Mycelium with clamps. F: Conidia. G-K: **Glomerulomyces fibulosus.** G: Conidiophores with conidia in compact , globose heads. H:Conidiogenous cell with one budding conidium. I: Budding conidia. J: Cluster of mature conidia. K: Conidium.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um diam composito. Conidiophoriis semimacronematis, simplicibus et ramosis, fibulatis, 30-40 x 2-4 um. Cellulis conidiogenis mono-polyblasticis, ellipsoideis, hyalinis, 8-10 x 4-5 um. Conidiis holoblasticis, globosis, hyalinis, aseptatis, 6-10 um diam, gemmiferis, in capituliis globosis compactis, 20-25 um diam.

HOLOTYPUS: Argentina, Buenos Aires, Ramallo; leg.: Romero, Cabral & Lopez, VIII-1982, ad partem amputatam trunci **Eucalyptus viminalis**, in Herb. BAFC N° 30829 conservatus est.

Etymology: **fibula** Latin for clamps

Teleomorph: unknown.

Conidiomata on bark and wood, effuse, pelliculose, farinaceous, chalkly white to cream. Hyphae hyaline, with clamps, 2.5-5 um diam. Conidiophores semimacronematous, simple or branched, with clamps, 30-40 x 2-4 um. Conidiogenous cells mono-polyblastic, ellipsoida, hyaline, 8-10 x 4-5 um. Conidia holoblastic, spherical, hyaline, aseptate, 6-10 um diam, budding in several directions to produce compact globose heads, 20-25 um diam.

Material studied: the holotype.

Remarks: When first looked at, this fungus resembles **Papulospora**, **Burgoa** and allied genera, because the cluster of conidia appears as a bulbil. We rejected **Papulospora** because this is restricted to the anamorph of some Ascomycetes. On the other hand, the conidial structure in **Glomerulomyces** is not a bulbil as in **Burgoa** and allied genera. Budding and development in the former results in a compact conidial head with different number of cells and colour, whereas in the latter genus budding originates a pseudoparenchymatous structure called a "bulbil" (Weresub et al., 1971).

In the slides, the heads of **Glomerulomyces** can be easily separeted in cells proving they are conidia rather than pseudoparenchymatous cells.

We should take in account another bulbillous species, **Aegerita** state, which form a cluster of apically enlarged and radially arranged hyphae as a prosenchymatous propagule (Kendrick & Watling, 1979), but this is not our case.

4.a. **Allescheriella cyanea** Cabral & Romero, sp. nov. (Fig. 2: A-D)

Coloniae ad corticem et lignum, e parvis maculis conformatae, adpressae, interdum coalescentes in magna extensione, resupinatae, marginibus indefiniti, paginis iridiscentes, laeves vel tuberculatae, sub lente aspectu crystallino, resentes azureae virellae (M & P, Pl 38 L-1 vel L-7) et margine albo, siccae virides. Mycelio paucis, hyphis tenuitertunicatis afibulatis e quibus conidiophora enascentibus, et hyphis tenuis, fibulatis, plus minusve parallelibus ad substratum, composito. Conidiophoriis mononematosis, micro vel semimacronematosis, simplicibus vel ramosis, flexuosis, hyalinis. Cellulis conidiogenis monoblasticis, cylindricis, terminalibus, interdum intercalaribus. Conidiis globosis, 13-20 um diam, subglobosis vel late ellipsoideis, 13-15 x 17-22 (28) um, laeviter pigmentiferis, crassitunicatis 3-4 um crassis, stratosis, continentibus granulosis et guttulosis, dextri-

noideis.

HOLOTYPUS: Argentina, Buenos Aires, Gobernador Castro; leg.: Romero, Cabral & Lopez, II-1982, ad partem amputatam trunci **Eucalyptus viminalis**, in Herb. BAFC Nº 30830 conservatus est.

Etymology: **cyaneus** Latin for the blue colour of the colony in nature.

Teleomorph: unknown.

Conidiomata on bark and wood, composed of small compact spots, coalescing into large areas, irregular, with indistinct margin, surface smooth or tuberculate, under a lens with the aspect of sugar crystals because of the conidial mass; when fresh dark greenish-blue (M & P, Pl. 38 L-7) and white margin, when dry green "Juniper" (M & P, Pl. 31 H-4). Hyphae scanty, more or less parallel to the substrate, composed of thin walled hyphae without clamps from which the conidiophores arise, interlaced with thin clamped hyphae. Conidiophores mononematous, micro to seminematous, simple or branched, flexuose, hyaline. Conidiogenous cells monoblastic, integrate, discrete, terminal, occasionally intercalary, cylindrical. Conidia solitary, spherical 13-20 um diam, subspherical or widely ellipsoidal 13-15 x 17-22 (28) um, slightly pigmented, thick-walled 3-4 um thick, with several layers, contents granulose and with 2-3 large drops, with strong dextrinoid reaction.

Material studied: the holotype. Argentina, Buenos Aires, Ramallo; leg.: Romero, Cabral & Lopez, II-1983 (BAFC Nº 30831); ibid, Gobernador Castro, V-1982 (BAFC Nº 31273).

Remarks: this material has been previously illustrated and partially described by Lopez (1984). Despite the lack of the sporodochium and the presence of clamps it was included in the genus **Allescheriella** sensu Hughes (1951) and Ellis (1971) because of the conidial ontogeny-type and conidial morphology.

5.a. "Sporotrichum" azureum Wright & v. Arx apud v. Arx, Persoonia 7(2): 127-128, 1973. (Fig. 2: E-G).

Teleomorph: unknown

Material studied: Argentina, Buenos Aires, Gobernador Castro; leg.: Romero, Cabral & Lopez, V-1982 (BAFC Nº 30832).

Remarks: it was originally described from Argentina by Wright & v. Arx (von Arx, 1973). Kendrick & Watling (1979) suggested this anamorph would be better placed in **Allescheriella.** According to Stalpers (1984) this species belongs neither to **Sporotrichum** nor to **Allescheriella.** He believes it can be better placed in a genus of its own (pers. comm.), thus we have decided to maintain this genus name until Stalpers'revision is published.

6.a. Sporotrichum aurantiacum (Bull.: Fr.) Fr., Syst. Mycol. 3:423, 1832. (Fig.2: H-I).

Teleomorph: **Pycnoporellus metamorphosus** (Fuck.) Stalpers

Material studied: Argentina, Buenos Aires, Gobernador Castro; leg.: Romero, Cabral & Lopez, V-1982, (BAFC Nº 30833).

Remarks: the species has been recently described by Stalpers (1984) giving a complete diagnosis of both anamorph and teleomorph states. Our sample agrees with Stalpers'description (op.cit.) except for the absence of chlamydospores and crystals. We also observed dextrinoid reaction whereas Stalpers mentioned red reaction in KOH.

7.a. Haplotrichum curtisii (Berk.) Hol. Jechová, Ceská Mykol. 30: 3-4, 1976. (Fig.3: A-D).

Conidiomata on bark, resupinate, velvety, elastic, margin indistinct, rusty paler towards the margin. Mycelium of hyphae up to 10 um diam, thick-walled, wall up to 1 um, from which arise the conidiophores. Conidiophores erect, branched in right angles, pale brown, slightly tapering towards the tip. Conidiogenous cells polyblastic, inflated terminal or intercalary, bearing several denticles. Conidia holoblastic, spherical or subspherical 10-15 um diam, solitary or rarely in very short chains, pale golden brown, thick-walled, slightly ornamentated.

Teleomorph: **Botryobasidium vagum** (Berk. & Curt.) Rogers.

Material studied: Argentina, Buenos Aires, Ramallo; leg.: Romero, Cabral & Lopez, II-1982 (BAFC Nº 30834); ibid, Gobernador Castro, XI-1982 (BAFC Nº 30835).

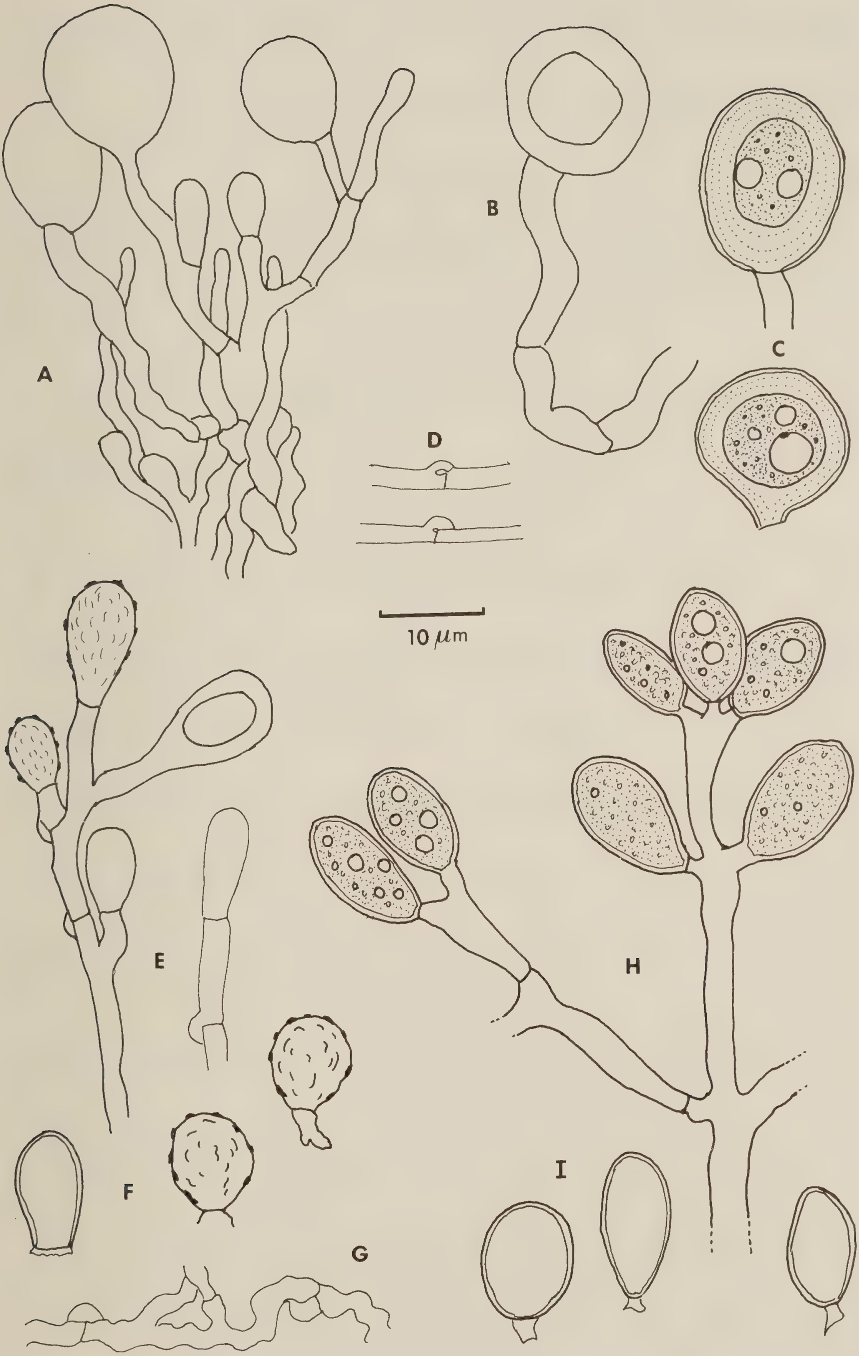
Remarks: it is the first record for Argentina.

7.b. Haplotrichum gracile (Linder) Hol. Jechová, Ceská Mycol. 30: 3-4, 1976. (Fig.3: E-G).

Conidioma on bark, effuse, cotton or velvety, loose, margin irregular, pale yellow. Mycelium scanty of hyphae with simple septa, 6-9 um diam, slightly yellow, wall rather thick. Conidiophores erect, few branched. Conidiogenous cells polyblastic, inflated, terminal and intercalary, bearing cylindrical denticles up to 1.5 um high. Conidia holoblastic, ellipsoidal, smooth to slightly ornamentated, pale yellow, truncate at the base, 8-9 x 10-14 um.

Teleomorph: unknown

FIGURE 2 : A-D : **Allescheriella cyanea.** A: Mycelium, branched conidiophores, conidiogenous cells and young conidia. B: Attached mature conidium. C: Mature conidia. D: Clamped hyphae. E-G : **"Sporotrichum" azureum.** E: Conidiophores. F: Young and mature conidia. G: Clamped hyphae. H-I : **Sporotrichum aurantiacum.** H: Conidiophores. I: Conidia.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Material studied: Argentina, Buenos Aires, Gobernador Castro, leg, Romero, Cabral & Lopez, XI-1981 (BAFC Nº 30836); ibid, XI-1982 (BAFC Nº 30837).

Remarks: it is the first record for Argentina.

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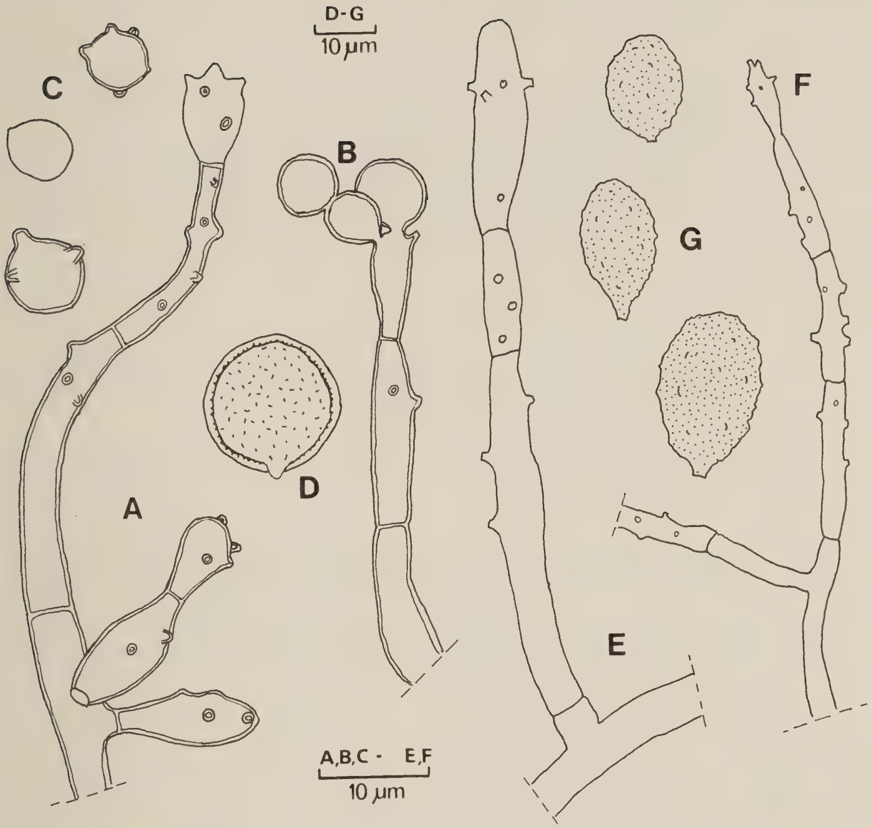

FIGURE 3 : A–D : **Haplotrichum curtisii.** A, B : Conidiophores with denticled conidiogenous cells and catenulate conidia. C : Young conidia. D : Mature conidia. E–G : **Haplotrichum gracile.** E, F : Conidiophores with denticled conidiogenous cells. G : Conidia.

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SYNOPSIS OF A REVISED CLASSIFICATION FOR THE ENTOMOPHTHORALES (ZYGOMYCOTINA)

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A revised classification of the Entomophthorales (Zygomycotina) based on expanded sets of familial and generic characters recognizes six families: Entomophthoraceae, Completoriaceae (fam. nov.), Ancylistaceae, Meristacraceae (fam. nov.), Neozygitaceae, and Basidiobolaceae. Characters with familial significance include several aspects of nuclear cytology, the modes of formation and germination of resting spores, and the nature of vegetative growth and development.

Primary generic characters all involve diverse aspects of the primary conidia: overall conidial and papillar morphology, nuclear number, uni- or bitunicate state of the wall, mode of discharge, and morphology of conidiophores and conidiogenous cells. Significant secondary generic characters include such correlated factors as the formation and morphology of any rhizoids and/or cystidia, the types of secondary conidia formed, and characteristics of resting spores (*e.g.*, color or decoration), vegetative cells (whether cells are walled or protoplastic, etc.), and general pathobiology (mode of action, host affinities, general habit, etc.).

Major changes in this revision include the following: The four Batkoan subgenera of *Zoophthora* are raised to genera as *Zoophthora* Batko, *Erynia* (Nowakowski ex Batko) Remaudière & Hennebert, *Furia* (Batko) Humber, and *Pandora* Humber [= *Erynia* (*Neopandora*) Ben-Ze'ev & Kenneth]. *Entomophaga* Batko is restricted to species with pyriform conidia and forming no rhizoids, and *Batkoa* Humber is segregated for species with globose conidia formed on conidiogenous cells with a narrowed apical extension and that may form rhizoids with discoid holdfasts. An emended description of *Conidiobolus* (Ancylistaceae) provides the first morphological and developmental separation of this genus from *Entomophaga* and *Batkoa* (Entomophthoraceae). The Completoriaceae (fam. nov.) is described for *Completoria complens*, an obligate, intracellular parasite of fern prothallia. The Meristacraceae (fam. nov.) includes genera forming several conidia on erect, unbranched conidiogenous axes. The descriptions of the four previously accepted families are modified to include all characters accepted here as having familial value.

The description of the Neozygitaceae and the segregation of *Thaxterosporium* from *Neozygites* (Ben-Ze'ev *et al.*, 1987) seemed to have modified the taxonomic criteria used to delimit entomophthoralean taxa (Humber, 1981, 1982, 1984a; Ben-Ze'ev & Kenneth, 1982a). While this new family and new genus are appropriate additions to entomophthoralean systematics, their acceptance suggested the need to re-evaluate and to expand the range of taxonomic criteria accorded generic and familial value. As a result of the ensuing taxonomic analysis, several new familial and generic characters are recognized. The uniform application of these augmented taxonomic filters to all entomophthoralean fungi has indicated the further need to adjust the classification presented by Ben-Ze'ev & Kenneth (1982a,b) and Humber (1984a). The revised classification is presented in Table 1.

The review of all taxa within the order has revealed some nomenclatural problems. To the greatest extent possible, these problems are remedied here. The most notable among them is the discovery that *Erynia* Nowakowski (1881), which has been accepted by many authors as a valid generic name, is an invalidly published *nomen nudum*. The ramifications of this finding are discussed in some detail below, and should help guarantee the early acceptance of generic status for the four Batkoan subgenera of *Zoophthora*.

REVISED FAMILIAL AND GENERIC CRITERIA

A comprehensive treatment of the revised classification presented in Table 1 is being presented for publication elsewhere (Humber, 1989). This monograph includes extended discussions about (1) the emergence of the current systematics of the Entomophthorales, (2) the application of characters accorded familial and generic value (with special emphasis on critical nuclear characters which have never been discussed in depth in previous publications and on other aspects of development of resting spores and vegetative cells introduced in this new classification), (3) some of the means now being adopted to distinguish species and species complexes, and (4) the evolutionary position of the Entomophthorales among the Zygomycetes. The systematic part of the full monograph provides detailed descriptions of all families, genera, and subgenera, complete bibliographic citations and synonymies of all taxa, information about the types of all species, and includes new combinations and new species not included in this synopsis. A synoptic key to the families, genera, and subgenera (Humber, 1989) is the first comprehensive key to use the post-Batkoan classification of this order.

Families or other higher level taxonomic ranks should never be defined by single characters or small set of narrowly related characters; good systematics always depends upon the correlation of the largest possible number of fundamentally diverse characters. Humber (1981, 1984a) provided bases for the use of nuclear cytological characters to de-

Table 1. Families and Genera of the Entomophthorales. This revised classification is fully elaborated in Humber (1989). It incorporates larger sets of familial and generic characters than those accepted by Humber (1981, 1982, 1984), Tucker (1981), and Ben-Ze'ev & Kenneth (1982a-b). Correction of nomenclatural errors have required the adoption of author attributions for some taxa that differ from those previously accepted as correct.

- **ENTOMOPHTHORACEAE** Winter
  - *Batkoa* Humber, **gen. nov.**
  - *Entomophaga* Batko
  - *Entomophthora* Fresenius
  - *Erynia* (Nowakowski ex Batko) Remaudière & Hennebert
  - *Eryniopsis* Humber
  - *Furia* (Batko) Humber, **stat. nov.**
  - *Massospora* Peck
  - *Pandora* Humber, **gen. nov.**
  - *Strongwellsea* Batko & Weiser
  - *Tarichium* Cohn
  - *Zoophthora* Batko

- **COMPLETORIACEAE** Humber, **fam. nov.**
  - *Completoria* Lohde

- **MERISTACRACEAE** Humber, **fam. nov.**
  - *Ballocephala* Drechsler
  - *Meristacrum* Drechsler
  - *Zygnemomyces* Miura

- **ANCYLISTACEAE** Fisher
  - *Ancylistes* Pfitzer
  - *Conidiobolus* Brefeld
    - subgenus *Conidiobolus*
    - subgenus *Capillidium* Ben-Ze'ev & Kenneth
    - subgenus *Delacroixia* (Saccardo & Sydow) Tyrrell & MacLeod
  - *Macrobiotophthora* Reukauf

- **NEOZYGITACEAE** Ben-Ze'ev & Kenneth in Ben-Ze'ev, Kenneth & Uziel
  - *Neozygites* Witlaczil
  - *Thaxterosporium* Be-Ze'ev & Kenneth in Ben-Ze'ev, Kenneth & Uziel

- **BASIDIOBOLACEAE** Claussen in Engler & Gilg
  - *Basidiobolus* Eidam

fine families within the Entomophthorales, but the application of these characters has been open to some misinterpretation. These significant cytological characters include the relative nuclear size and appearance and the quantity and distribution of any condensed chromatin during interphase, the morphology of mitotic chromosomes, the relative placement of the spindle at metaphase, and fate of the nuclear envelope during mitosis.

This current revision adds several new characters (involving resting spores and vegetative cells) to those cytological characters useful for circumscribing families. The resting spores characters include (1) the mode of formation (either axially aligned with the parental cell or budded through a narrow isthmus), (2) the presence or absence of a round of preconjugational gametangial mitosis, and (3) the mode of germination (with germ conidiophores forming directly from the spore or indirectly on a limited germ mycelium). The nature of vegetative cells seems to be useful at both familial and generic ranks. These cells may be walled or protoplastic; they may be multi-, pluri-. or uninucleate; their shape may be as hyphae forming a recognizable mycelium, as variably shaped hyphal bodies, as yeasts, or as botryose plasmodia; and, in relation to the host cells, fungal growth and development may be intracellular or matrical (in the hemocoel or other intercellular spaces).

Primary and secondary sets of characters are recognized for delimiting entomophthoralean genera. The primary characters elaborated previously (Humber 1981, 1984a; Ben-Ze'ev & Kenneth, 1982a) focus on primary conidia: the number of conidial nuclei, conidial morphology, uni- or bitunicate nature of the conidial wall, the mode of conidial discharge, and the morphology of the conidiophore and/or conidiogenous cell. One or more secondary characters should be invoked for the separation of genera only if they show strong correlations to variations in at least one of the primary generic characters. In the absence of significant variations in one or more primary characters, variations in secondary characters may serve as a reasonable basis for distinguishing subgenera.

Secondary generic characters include (1) the presence (and morphology) of any rhizoids and/or cystidia, (2) the types of secondary conidia formed, (3) resting spore characters (*e.g.*, unusual decorations, full separation of endospore and epispore, melanic or other characteristic colors, etc.), (4) vegetative characters (which are listed above), and (5) pathobiology *(e.g.*, host range, mode of pathogenesis, habitat). Further secondary characters may yet be recognized, but any such additional characters must have legitimate significance and not be accepted merely for the convenience of justifying a particular taxonomic opinion. The secondary characters listed here are all relatively major features which appear to involve considerable portions of the fungal genome.

The following two examples illustrate the care with which secondary generic characters must be used: In the first major post-Batkoan classification (Remaudière & Hennebert, 1980; Remaudière & Keller, 1980), the formation of secondary capilliconidia was the only unique character which distinguished *Zoophthora* from *Erynia*; the adoption of these two genera was rejected in favor of retaining the species in all of Batko's (1966) subgenera of *Zoophthora* in one genus (Humber & Ben-Ze'ev, 1981; Ben-Ze'ev & Kenneth, 1982b; Li & Humber, 1984). There are subtle but reasonably consistent differences in conidial morphology among these subgenera, and some minor variation in the degree of branching of the conidiophores; these subtle differences in primary characters cannot, in themselves, justify the elevation of these subgenera to generic rank. These variations in primary characters are, however, strongly correlated with marked differences among all subgenera in the morphologies of rhizoids and cystidia, in the overall host range and habitat, and, apparently, in the walled or protoplastic nature of the vegetative cells. None of these differences in secondary characters is individually sufficient to warrant a change from subgeneric to generic rank, but when the entire range of primary *and* secondary characters are taken together, there is ample basis to raise the Batkoan subgenera of *Zoophthora* to generic status. The three subgenera of *Conidiobolus* (Ben-Ze'ev & Kenneth, 1982a) provide a second valuable example for the application of secondary generic characters. These subgenera are separated by only one secondary character, their types of secondary conidia formed. Because there are no significant differences among the subgenera in any primary generic characters, these secondary differences cannot be recognized reasonably as taxonomically different at any rank higher than the subgenus.

NEW TAXA, COMBINATIONS, AND EMENDATIONS

The formal descriptions and combinations required to validate the classification in Table 1, and to allow the immediate adoption of this classification are provided in this section. For most users, the major changes proposed herein include (1) the subgenera of *Erynia* sensu Humber & Ben-Ze'ev (1981; Ben-Ze'ev & Kenneth, 1982b) are elevated to generic rank, (2) notice that the use of *Erynia* in the broad sense (Humber & Ben-Ze'ev, 1981) was nomenclaturally incorrect, and (3) the segregation of *Batkoa* from *Entomophaga* for species with globose conidia borne on narrowed extensions of the conidiogenous cell and which may also produce rhizoids with discoid holdfasts.

Except where specifically listed below, the species accepted in any other genus in this present classification generally agree with those listed by Tucker (1981), Ben-Ze'ev & Kenneth (1982a-b), and Ben-Ze'ev *et al.* (1987). Further new species not treated in this synopsis will appear in the full monographic treatment of this revised classification (Humber, 1989).

ENTOMOPHTHORACEAE Winter

Early vegetative stage mycelial, or hyphal bodies with or without distinct cell walls, or fusoid to catenate or irregularly shaped amoeboid protoplasts. Nuclei typically 5-12 μm (but as little as 2.5-3.0 μm) diameter during interphase, containing much condensed chromatin that usually stains readily with aceto-orcein or bismarck brown; no prominent central nucleolus; usually arranged in single file in coenocytic to infrequently septate hyphae. Nuclei remain distinctly visible throughout mitosis; mitosis intranuclear (with nuclear envelope remaining intact and closed throughout mitosis); chromosomes more or less distinct and vermiform during late mitotic stages. Conidiophores simple or dichotomously to digitately branched; conidiogenous cells apical on each conidiophore branch. Primary conidia unitunicate or bitunicate; forcibly discharged by papillar eversion or on a propulsive jet of conidiophore contents, or passively dispersed from numerous conidiogenous cavities interspersed in an easily dissociated fungal mass. Resting spores form as lateral or terminal buds connected to parental cell by narrow isthmus. Obligate pathogens of insects or other arthropods.

Type genus: *Entomophthora* Fresenius

Batkoa Humber, **gen. nov.**

[= *Entomophaga* subgenus *Lichia* Weiser & Batko in Batko & Weiser, 1965, J. Invertebr. Pathol. 7: 461. (*nomen nudum*, without diagnosis)]

Cellulae vegetativae hyphae vel corpora hyphalia filamentosa. Nuclei grandiusculi, granulis heterochromatis et prompte per "aceto-orcein" vel "Bismarck brown" coloratis repleto; nucleolo parvo eccentrico. Apparatus mitoticus parvus fusiformis eccentricus per metaphasem; chromosomata vermiformes spatium nuclei subtotum adsument per metaphasem. Conidiophora simplicia; apice cellulis conidiogenis plerumque attenuato exserto. Cystidia hymenica desunt. Conidia primaria globosa subglobosa, unitunicata, multinucleata; vehementer eversione papillae basalis expulsa. Rhizoidea aliquando praesentia, cellula conidiogena multo crassius, singularia (nonfasciculata), haptero apicali disciformi vel irregulariter ramoso ut in speciebus Pandorae. Sporae perdurantes ex cellula parentali pullulantes et mycelium germinale formantes per germinationem. Species Entomophthoracearum pathogeniae obligatae hospites insectorum.

Vegetative cells hyphal or in thread-like hyphal bodies, apparently with a cell wall in natural hosts. Nuclei relatively large, with prominent granules of condensed chromatin during interphase, staining readily with aceto-orcein, Bismarck brown, or other nuclear stains; nucleolus small, irregular, randomly located. Mitotic spindle small and eccentric during metaphase, chromosomal arms filling nuclear volume; chromosomal arms radiating from chromatin-free zone around spindle poles, arranged in dome-like fashion during anaphase. Conidiophores simple, conidiogenous cells with tendency for neck-like apical narrowing immediately below conidium. Cystidia absent from hymenium. Primary conidia globose to subglobose, unitunicate, multinucleate; forcibly discharged by papillar eversion. Rhizoids occasionally present; if so, distinctly thicker than vegetative hyphae or conidiophores, occurring singly, with discoid terminal holdfast (resembling that of *Pandora* species). Resting spores arising by budding from parental cell, and assumed to germinate indirectly by formation of germ mycelium. Obligately entomopathogenic, with most species affecting Homoptera, Hemiptera, or other insects in moist environments.

Type species: *Batkoa apiculata* (Thaxter) Humber, comb. nov. Basionym: *Empusa apiculata* Thaxter, 1888, Mem. Boston Soc. Nat. Hist. 4: 163. **Lectotype**: FH 4331. [= *Entomophaga domestica* Keller, 1987, Sydowia 40: 141.]

Other included species:

***Batkoa dysderci* (Viégas) Humber, comb. nov.** Basionym: *Empusa dysderci* Viégas, 1939, Jorn. Agron. 2: 251.

***Batkoa gigantea* (Keller) Humber, comb. nov.** Basionym: *Entomophthora gigantea* Keller, 1978, Sydowia, Ann. Mycol. (Ser. II) 31: 89.

Batkoa major (Thaxter) Humber, **comb. nov.** Basionym: *Empusa apiculata* var. *major* Thaxter, 1888, Mem. Boston Soc. Nat. Hist. 4: 163. **Lectotype**: FH 4306. [= *Entomophaga limoniae* Keller, 1987, Sydowia 40: 146.]

Batkoa papillata (Thaxter) Humber, **comb. nov.** Basionym: *Empusa papillata* Thaxter, 1888, Mem. Boston Soc. Nat. Hist. 4: 166. **Neotype**: FH 3316.

Thaxter (1888) designated no types for the new species described in his monograph. The correct disposition of *Empusa apiculata*, *E. major*, and *E. papillata* among the Entomophthoraceae (Ben-Ze'ev & Kenneth 1982a) or the Ancylistaceae (Remaudière & Keller, 1980; Keller, 1987) depends wholly upon the familial affinities of the nomenclatural type specimens that must be designated from among Thaxter's authentic collections. Virtually all specimens of *E. apiculata* and *E. major* used to prepare Thaxter's (1888) monograph proved to have entomophthoraceous nuclei. Because a thorough search of the entomophthoralean specimens at the Farlow Herbarium (FH) disclosed no authentic specimens of *B. papillata*, I neotypified *E. papillata* with the only other FH collection of this species, a specimen whose nuclei were clearly entomophthoraceous. A lectotype for *B. papillata* must be chosen to supercede this neotype if Thaxter's authentic specimens are ever located.

The typifications of *B. apiculata*, *B. major*, and *B. papillata* fix the placements of these species among the Entomophthoraceae. The ancylistaceous species identified by Keller (1987) as *Conidiobolus apiculatus* (Thax.) Remaud. & Keller and as *Conidiobolus major* (Thax.) Remaud. & Keller must be described as new *Conidiobolus* species while their entomophthoraceous "pairs", *Entomophaga domestica* Keller and *Entomophaga limoniae* must be synonymized with the Thaxterian species here placed in *Batkoa*.

Entomophaga Batko emend. Humber, **emend. nov.**

Vegetative cells as hyphoid or more or less beaded hyphal bodies to individual fusoid cells; usually wall-less protoplasts during early stages of development. Nuclei relatively large, with prominent granules of condensed chromatin during interphase, staining readily with aceto-orcein or other nuclear stains; nucleolus small, irregular, randomly located. Mitotic spindle small and eccentric during metaphase, chromosomal arms filling nuclear volume; chromosomal arms radiating from chromatin-free zone around spindle poles, arranged in dome-like fashion during anaphase. Conidiophores simple, conidia produced directly on apex without arising on a narrower neck-like extension. Cystidia absent from hymenium. Primary conidia pyriform, unitunicate, multinucleate, with more or less prominent papilla; forcibly discharged by papillar eversion; on waterlogged specimens, (coronate) primary conidia with 2+ distal projections may be formed and passively dispersed. Rhizoids absent. Resting spores arise by budding from parental cell, and germinate indirectly by formation of germ mycelium. Obligately entomopathogenic.

Type species: ***Entomophaga grylli*** (Fresenius) Batko, 1964, Bull. Acad. Polon. Sci., Sér. Sci. Biol., 12: 325.

Other included species:

E. aulicae (Reichardt in Bail) Humber, 1984, Mycotaxon 21: 270

E. batkoi (Balazy) Keller, 1987, Sydowia 40: 138.

Entomophaga calopteni (Bessey) Humber, **comb. nov.** Basionym: *Entomophthora calopteni* Bessey, 1883, Amer. Nat. 17: 1280.

E. conglomerata (Sorokin) Keller, 1987, Sydowia 40: 138.

E. kansana (Hutchison) Batko, 1964, Bull. Acad. Polon. Sci., Sér. Sci. Biol., 12: 404.
E. saccharina (Giard) Batko, 1964, Bull. Acad. Polon. Sci., Sér. Sci. Biol., 12: 404.
E. tabanivora (Anderson & Magnarelli) Humber, 1984, Mycotaxon 21: 270.
E. tenthredinis (Fresenius) Batko [Bull. Acad. Polon. Sci., Sér. Sci. Biol., 12: 404.
Entomophaga tipulae (Fresenius) Humber, **comb. nov.** Basionym: *Entomophthora tipulae* Fresenius, 1858, Abhandl. Senckenb. Naturf. Ges. 2: 206.

This emended generic description recognizes the ability of some *Entomophaga* species to form multiradiate primary or secondary conidia on waterlogged specimens. Descals & Webster (1984) noted the formation of such conidia by *E. tipulae* (as the invalidly published synonym, *Entomophthora thaxteri* Brumpt); such conidial behavior had been known previously only from species of *Erynia* (*sensu stricto*).

Entomophaga calopteni was originally described as a pathogen of the differential grasshopper, *Melanoplus* (= *Caloptenus*) *differentialis*. This name is adopted for the North American member of the *E. grylli* species complex that attacks spur-throated grasshoppers (*Melanoplus* spp.; Orthoptera: Acrididae), and produces resting spores but no conidia under normal conditions either in the host or in culture. *E. calopteni* is more widely known in the literature as the North American pathotype II of *E. grylli* (Soper *et al*., 1983; Humber 1984b). The North American pathotype I of *E. grylli* (Soper *et al*., 1983; Humber 1984b) freely produces conidia and attacks hosts from genera other than *Melanoplus*; this fungus and other members of this species complex from non-European locations will be described later as new species (Humber, 1989).

Entomophthora Fresenius

The complex of species which includes *E. muscae* (Cohn) Fresenius, the type species of *Entomophthora*, now also includes *E. israelensis* Ben-Ze'ev & Zelig (= *E. brevinucleata* Keller & Wilding), *E. scatophagae* Giard (Steinkraus and Kramer, 1988), *E. schizophorae* Keller & Wilding in Keller (1987, p. 160), and *E. trinucleata* Keller (1987, p. 161), Other *Entomophthora* species include *E. culicis* (Braun) Fresenius; *E. erupta* (Dustan) Hall; *E. helvetica* Keller & Ben-Ze'ev in Ben-Ze'ev, Keller & MacEwen; *E. planchoniana* Cornu; *E. thripidum* Samson, Ramakers & Oswald; and *E. weberi* Lakon ex Samson in Samson, Ramakers & Oswald.

Erynia (Nowakowski ex Batko) Remaudière & Hennebert emend. Humber, **emend. nov.**

≡ *Zoophthora* subgenus *Erynia* Nowakowski ex Batko, 1966, Acta Mycol. 2: 18.
≡ *Erynia* (Nowakowski ex Batko) Remaudière & Hennebert, 1980, Mycotaxon 11: 301.

Vegetative cells as hyphal bodies, apparently with cell walls in natural hosts. Nuclei medium to large, with prominent granules of condensed chromatin during interphase, staining readily with aceto-orcein or other nuclear stains; nucleolus small, irregular, randomly located. Mitotic spindle small and eccentric during metaphase, chromosomal arms filling nuclear volume; chromosomal arms radiating from chromatin-free zone around spindle poles, arranged in dome-like fashion during anaphase. Conidiophores simple, arising from more or less spherical hyphal bodies; conidiogenous cells slightly clavate. Cystidia present in hymenia of all known species, at least twice as thick as conidiophores, occasionally branched, standing out well above layer of conidiophores. Primary conidia pyriform to elongate or fusoid, often strongly curved to lunate, with rounded to broadly conical basal papilla; bitunicate; uninucleate; forcibly discharged by papillar eversion, or, in waterlogged specimens, by passively dispersed (coronate) primary conidia with 2+ distal projections. Secondary conidia globose or resembling primary and forcibly discharged by papillar eversion, or, in waterlogged specimens, with 2+ proximal projections ("stellate secondary conidia") and passively dispersed. Rhizoids at least twice as thick as conidiophores or vegetative cells; without distinct terminal holdfast. Resting spores arise by budding from parental cell; assumed to germinate indirectly by formation of germ mycelium. Obligately entomopathogenic.

Type species: ***Erynia ovispora*** (Nowakowski) Remaudière & Hennebert, 1980, Mycotaxon 11: 301.

Other included species:

E. aquatica (Anderson & Anagnostakis) Humber. 1981. Mycotaxon 13: 213]

E. conica (Nowakowski) Remaudière & Hennebert, 1980, Mycotaxon 11: 302].

E. curvispora (Nowakowski) Remaudière & Hennebert, 1980, Mycotaxon 11: 302.

E. delpiniana (Cavara) Humber, 1981, Mycotaxon 13: 212]

E. erinacea (Ben-Ze'ev & Kenneth) Remaudière & Hennebert, 1980, Mycotaxon 11: 302.

E. gracilis (Thaxter) Remaudière & Hennebert, 1980, Mycotaxon 11: 302.

E. henrici (Molliard) Humber & Ben-Ze'ev, 1981, Mycotaxon 13: 509.

E. plecopteri Descals & Webster, 1984, Trans. Brit. Mycol. Soc. 83: 669.

E. rhizospora (Thaxter) Remaudière & Hennebert, 1980, Mycotaxon 11: 302.

E. sepulchralis (Thaxter) Remaudière & Hennebert, 1980, Mycotaxon 11: 302.

E. variabilis (Thaxter) Remaudière & Hennebert, 1980, Mycotaxon 11: 302.

The taxonomic authorities and synonymy accepted here for the name *Erynia* diverges markedly from that recognized in recent years. This generic name first appeared in a published report of a meeting of Polish physicians and biologists (Nowakowski, 1881). In this report, no characters were given to distinguish *Erynia* from *Empusa*, *Entomophthora*, or *Lamia*; *Erynia* Nowakowski (1881) is, therefore, an invalidly published *nomen nudum*. Nowakowski later rejected this genus since he did not mention *Erynia* and treated its intended species (*E. ovispora*, *E. conica*, and *E. curvispora*) as *Entomophthora* species in his monograph (Nowakowski, 1883); if *Erynia* had been validly published in 1881, this later rejection would have had no effect on the nomenclatural priority of the generic name. Batko (1966) did characterize, typify, and validate *Erynia* Nowakowski as a subgenus of *Zoophthora* despite his mistaken belief about the reasons for the invalidity of the generic name.

Remaudière & Hennebert (1980) were the first authors to use the validated *Erynia* at the generic rank even though they had accepted Nowakowski's (1881) mention of *Erynia* to be nomenclaturally valid. If the true status of *Erynia* Nowakowski (1881) had been known, Humber & Ben-Ze'ev (1981) and Ben-Ze'ev & Kenneth (1982a,b) would have recognized *Zoophthora* Batko (1964) as the oldest valid and nomenclaturally correct name for the genus in their broad sense rather than accepting *Erynia*. It is important to note that the taxonomy proposed in this revision is unaffected by these past nomenclatural errors since the type species of *Zoophthora* (*Z. radicans*) and *Erynia* (*E. ovispora*) are once again placed in separate genera as they had been by Remaudière & Hennebert (1980) and Remaudière & Keller (1980).

Furia (Batko) Humber, **stat. gen. nov. et emend. nov.**

≡ *Zoophthora* subgenus *Furia* Batko, 1966, Acta Zool. 2: 20.
≡ *Erynia* subgenus *Furia* (Batko) Li & Humber, 1984, Canad. J. Bot. 62: 662.

Vegetative growth in vivo as hyphoid protoplasts or walled hyphal bodies. Nuclei large, generally ≥5 μm diameter, with prominent condensed chromatin during interphase, staining readily with aceto-orcein and other nuclear stains. Mitotic metaphase plate small, lateral, and occupied by kinetochores while chromosomal arms occupy remaining nuclear volume. Conidiophores with low order of apical branching (not prominently digitate), intertwined in dense hymenia. Cystidia as thick as conidiophores, unbranched, tapering apically. Primary conidia ovoid to cylindrical, obpyriform to obclavate or fusoid, with no strong tendency to show bilateral symmetry (basal papilla may be displaced laterally from spore axis); uninucleate; bitunicate (outer wall layer may separate in liquid); forcibly discharged by papillar eversion. Secondary conidia more or less resembling primary conidia, produced singly on primary conidia; forcibly discharged by papillar eversion; capilliconidia absent. Rhizoids monohyphal or fasciculate or (rarely?) pseudorhizomorphic; no thicker than conidiophores; with no strongly differentiated terminal holdfast, or with small, sucker-like expansions near apices, or with few, irregular, thin, short terminal branches spreading on substrate.

Type species: *Furia virescens* (Thaxter) Humber, **comb. nov.** Basionym: *Empusa virescens* Thaxter, 1888, Mem. Boston Soc. Nat. Hist. 4: 178.

Other included species:

Furia americana (Thaxter) Humber, **comb. nov.** Basionym: *Empusa* (*Entomophthora*) *americana* Thaxter, 1888, Mem. Boston Soc. Nat. Hist. 4: 179.

Furia creatonoti (Yen in Humber) Humber, **comb. nov.** Basionym: *Erynia creatonoti* Yen in Humber, 1981, Mycotaxon 13: 474.

Furia crustosa (MacLeod & Tyrrell) Humber, **comb. nov.** Basionym: *Entomophthora crustosa* MacLeod & Tyrrell, 1979, Canad. Entomol. 111: 1138.

Furia ellisiana (Ben-Ze'ev) Humber, **comb. nov.** Basionym: *Erynia ellisiana* Ben-Ze'ev, 1986, Mycotaxon 27: 266.

Furia ithacensis (Kramer) Humber, **comb. nov.** Basionym: *Erynia ithacensis* Kramer, 1981, Mycopathologia 75: 160.

Furia montana (Thaxter) Humber, **comb. nov.** Basionym: *Empusa montana* Thaxter, 1888, Mem. Boston Soc. Nat. Hist. 4: 180.

Furia neopyralidarum (Ben-Ze'ev) Humber, **comb. nov.** Basionym: *Erynia neopyralidarum* Ben-Ze'ev, 1982, Mycotaxon 16: 276.

Furia pieris (Li & Humber) Humber, **comb. nov.** Basionym: *Erynia pieris* Li & Humber, 1984, Canad. J. Bot. 62: 656.

Furia sciarae (Olive) Humber, **comb. nov.** Basionym: *Empusa sciarae* Olive, 1906, Bot. Gaz. (Crawfordsville) 41: 196.

Furia vomitoriae (Rozsypal) Humber, **comb. nov.** Basionym: *Zoophthora vomitoriae* Rozsypal, 1966, Acta Mycol. 2: 24.

Furia zabri (Rozsypal ex Ben-Ze'ev & Kenneth) Humber, **comb. nov.** Basionym: *Erynia zabri* Rozsypal ex Ben-Ze'ev & Kenneth (as *E. zabrii*), 1982, Mycotaxon 14: 465.

The placement of so many species in *Furia* may rightfully be questioned since Batko (1966) and Li & Humber (1984) regarded this to be a limited group and since Ben-Ze'ev & Kenneth (1982b) declined to place several of the species included here in any *Erynia* subgenus. The morphology of primary conidia in *Furia* species is virtually indistinguishable from that of *Pandora* species, but is distinct from the elongate or to prominently cylindrical conidia of many species of *Erynia* s.str. and *Zoophthora* s.str.. *Furia* species are readily distinguished from *Pandora* species, however, by their rhizoids and/or cystidia. In *Furia*, the rhizoids are no thicker than vegetative hyphae; these structures may be solitary, fasciculate, or even bundled into pseudorhizomorphs (like those of some *Entomophthora* or *Zoophthora* species), but have either no differentiated terminal holdfasts, rudimentary suckers or sparse, open systems of thin branches (which may even be arranged in a discoid fashion). The rhizoids of *Furia* species are neither so thick as those of *Pandora* species, nor do they ever possess the massive, solid discoid holdfast of the latter genus (in which rhizoids are solitary rather than fasciculate). In the erynioid genera, the thickness of the cystidia matches that of the rhizoids; in *Furia*, cystidia are no thicker than vegetative hyphae or conidiogenous cells; as in other genera, they taper apically.

Pandora Humber, **gen. nov.**

= *Zoophthora* subgenus *Pandora* Batko [pro parte], 1966, Acta Mycol. 2: 18. [as described but excluding the designated type, *Entomophthora aphidis* Hoffmann in Fres., which is a species of *Zoophthora* sensu stricto]

= *Erynia* subgenus *Neopandora* Ben-Ze'ev & Kenneth, 1982, Mycotaxon 14: 460.

Cellulae vegetativae plerumque filamentosae in vivo protoplastes sive parietatae. Nuclei magni, ≥ 5 µm diam., granulis heterochromatis et prompte per "aceto-orcein" vel "Bis-

marck brown" coloratis repleto; nucleolo parvo eccenrico. Apparatus mitoticus parvus fusiformis eccentricus per metaphasem; chromosomata vermiformes spatium nuclei subtotum adsument per metaphasem. Conidiophora digitata apicale, in hymeniis densis intertextis. Cystidia hymenica attenuata plerumque praesentia, cellula conidiogena 2-3plo crassius. Conidia primaria ovoidea subcylindrica, papilla basali axiali vel laterali, uninucleata, bitunicata; vehementer eversione papilla basali expulsa. Conidia secundaria solitaria, vehementer eversione papilla expulsa; capilliconidia desunt. Rhizoidea solitaria, cellula conidiogena 2-3plo crassius, vacuolata, haptero apicali disciformi vel irregulariter ramoso terminantia. Sporae perdurantes ex cellula parentali pullulantes et mycelium germinale formantes per germinationem. Species Entomophthoracearum pathogeniae obligatae hospites insectis arachnidis.

Vegetative growth *in vivo* as hyphoid protoplasts or walled hyphal bodies. Nuclei large, generally ≥5 μm diameter, with prominent condensed chromatin during interphase, staining readily with aceto-orcein and other nuclear stains. Mitotic metaphase plate small, lateral, and occupied by kinetochores while chromosomal arms occupy remaining nuclear volume. Conidiophores digitately branched at apices (rarely bifurcate or simple), intertwined in dense hymenia. Cystidia usually present, 2-3 times thicker than conidiophores, tapering apically. Primary conidia ovoid to cylindrical, obpyriform to obclavate or fusoid, with no strong tendency to show bilateral symmetry (basal papilla may be displaced laterally from spore axis); uninucleate; bitunicate (outer wall layer may separate in liquid); forcibly discharged by papillar eversion. Secondary conidia more or less resembling primary conidia, produced singly on primary conidia; forcibly discharged by papillar eversion; capilliconidia absent. Rhizoids monohyphal, 2-3 times thicker than conidiophores, highly vacuolate, terminating in discoid or irregularly branched and spreading holdfast.

Type species: ***Pandora neoaphidis*** (Rem. & Henn.) Humber, **comb. nov.** Basionym: *Erynia neoaphidis* Remaudière & Hennebert, 1980, Mycotaxon 11: 307.

Other included species:

Pandora blunckii (Lakon ex Zimmermann) Humber, **comb. nov.** Basionym: *Entomophthora blunckii* Lakon ex Zimmermann, 1978, Entomophaga 23: 182.

Pandora brahminae (Bose & Mehta) Humber, **comb. nov.** Basionym: *Entomophthora brahminae* Bose & Mehta, 1953, Trans. Brit. Mycol. Soc. 36: 55.

Pandora bullata (Thaxter & MacLeod in Humber) Humber, **comb. nov.** Basionym: *Erynia bullata* Thaxter & MacLeod in Humber, 1981, Mycotaxon 13: 472.

Pandora calliphorae (Giard) Humber, **comb. nov.** Basionym: *Entomophthora calliphorae* Giard, 1879, Bull. Sci. Dep. Nord, Sér. 2, 2: 356.

Pandora dacnusae (Balazy) Humber, **comb. nov.** Basionym: *Erynia dacnusae* Balazy, 1981 (1982), Bull. Acad. Polon. Sci., Sér. Sci. Biol. 29: 229.

Pandora delphacis (Hori) Humber, **comb. nov.** Basionym: *Entomophthora delphacis* Hori, 1906, Entomol. Mag. (Tokyo) 3: 81.

Pandora dipterigena (Thaxter) Humber, **comb. nov.** Basionym: *Empusa dipterigena* Thaxter, 1888, Mem. Boston Soc. Nat. Hist. 4: 177.

Pandora echinospora (Thaxter) Humber, **comb. nov.** Basionym: *Empusa echinospora* Thaxter, 1888, Mem. Boston Soc. Nat. Hist. 4: 180.

Pandora formicae (Humber & Balazy in Humber) Humber, **comb. nov.** Basionym: *Erynia formicae* Humber & Balazy in Humber, 1981, Mycotaxon 13: 475.

Pandora gammae (Weiser) Humber, **comb. nov.** Basionym: *Tarichium gammae* Weiser, 1965, Ceska Mykol. 19: 203.

Pandora gloeospora (Vuillemin) Humber, **comb. nov.** Basionym: *Entomophthora gloeospora* Vuillemin, 1886, Bull. Soc. Sci. Nat. Nancy, Sér. 2, 19: 34.

Pandora kondoiensis (Milner in Milner, Mahon & Brown) Humber, **comb. nov.** Basionym: *Erynia kondoiensis* Milner in Milner, Mahon & Brown, 1983, Austral. J. Bot. 31: 183.

Pandora nouryi (Remaudière & Hennebert) Humber, **comb. nov.** Basionym: *Erynia nouryi* Remaudière & Hennebert, 1980, Mycotaxon 11: 313.

Pandora phalangicida (Lagerheim) Humber, **comb. nov.** Basionym: *Entomophthora phalangicida* Lagerheim, 1898, Bihang Svensk. Vet. Akad. Handl. 24: 12.

Pandora suturalis (Ben-Ze'ev) Humber, **comb. nov.** Basionym: *Erynia (Neopandora) suturalis* Ben-Ze'ev, 1987, Mycotaxon 28: 405.

Zoophthora Batko

Species included in this genus, which is typified by *Z. radicans* (Brefeld) Batko, follow the listing accepted in *Erynia* (*Zoophthora*) by Ben-Ze'ev & Kenneth (1982b) together with two further species either added to this group or described as new. New combinations are provided for these two species:

Zoophthora anglica (Petch) Humber, **comb. nov.** Basionym: *Entomophthora anglica* Petch, 1944, Trans. Brit. Mycol. Soc. 27: 89.

Zoophthora anhuiensis (Li) Humber, **comb. nov.** Basionym: *Erynia anhuiensis* Li, 1986, Acta Mycol. Sin. 5: 2.

Z. aphidis (Hoffmann in Fresenius) Batko, 1964, Bull. Acad. Polon. Sci., Sér. Sci. Biol. 12: 405.

Z. canadensis (MacLeod, Tyrrell & Soper) Remaudière & Hennebert, 1980, Mycotaxon 11: 301.

Z. crassitunicata Keller, 1980, Sydowia Ann. Mycol., Ser. 2, 33: 170.

Zoophthora geometralis (Thaxter) Batko, 1964, Bull. Acad. Polon. Sci., Sér. Sci. Biol. 12: 404.

Z. lanceolata Keller, 1980, Sydowia Ann. Mycol., Ser. 2, 33: 167.

Z. occidentalis (Thaxter) Batko, 1964, Bull. Acad. Polon. Sci., Sér. Sci. Biol. 12: 404.

Z. orientalis Ben-Ze'ev & Kenneth, 1981, Phytoparasitica 9: 35.

Z. petchii Ben-Ze'ev & Kenneth (as *Z. petchi*), 1981, Entomophaga 26: 140.

Z. phalloides Batko, 1966, Acta Mycol. 2: 7.

Z. phytonomi (Arthur) Batko, 1964, Bull. Acad. Polon. Sci., Sér. Sci. Biol. 12: 404.

Z. radicans (Brefeld) Batko, 1964, Bull. Acad. Polon. Sci., Sér. Sci. Biol. 12: 323.

COMPLETORIACEAE Humber, **fam. nov.**

Cellulae vegetativae parvae botryosae irregulares probabiliter protoplastes in cellulis prothallorum filicium. Nuclei comparate magni chromatino granulato condensato per interphasem. Mitoses non vidi. Conidiophora simplicia brevia, ex cellulis vegetativis directe sine cellulis conidiogenis specialibus formantibus. Conidia primaria unitunicata, subglobosa, papilla pusilla rotundata; vehementer eversione papillae basalis expulsa. Sporae perdurantes globosae et parvae; in axe cellula parentali formare et per germinatione conidii germinalis formationibus directis adsumptae sunt. Genus monotypicus Entomophthoralium pathogeniae obligatae prothallis filicium.

Vegetative growth as small, botryose, irregular hyphal bodies inside cells of fern gametophyte; appearance and development suggest that no cell walls are present. Nuclei relatively large, filled with condensed chromatin at interphase (giving granular appearance to nucleoplasm); no mitoses observed. Conidiophores simple, short, arising directly from vegetative cells; no separate conidiogenous cell formed. Conidia unitunicate, subglobose, with small, rounded papilla; forcibly discharged by papillar eversion. Resting spores globose, but neither mode of formation nor of germination has been confirmed; resting spores apparently form in axis of parental cell; germination is probably by direct production of germ conidiophore and forcibly discharged conidium. Obligate intracellular parasite of fern gametophytes.

Type genus: *Completoria* Lohde

The inclusion of a monotypic family in this classification may seem odd, especially when so many key characters have been inferred rather than confirmed by observation. *Completoria complens* appears to be a rather rare fungus and has been observed only from greenhouse cultures where it grows as an intracellular parasite of fern gametophytes. I am unaware of any report of this fungus affecting field populations of gametophytes. The missing characters that have been "filled in" for this familial description were done so by choosing the most probable character states of characters for such a highly specific parasite. The accuracy of these guesses will provide a substantial test for the ability to use this classification to predict character states. *Completoria* was previously included in the Entomophthoraceae (Tucker, 1981; Ben-Ze'ev & Kenneth, 1982a; Humber, 1984a); removing *C. complens* leaves only obligately entomopathogenic species the Entomophthoraceae.

ANCYLISTACEAE Fisher

Vegetative growth as irregularly septate or coenocytic mycelium, tending to become disjointed with evacuation of cytoplasm from some cells and fragmentation of wall. Nuclei small, usually 3-5 µm long during interphase, with prominent central nucleolus; no significant quantity of condensed chromatic granular material in nucleoplasm during interphase (nuclei not staining strongly with aceto-orcein or bismarck brown). Nuclei usually difficult to observe during interphase or mitosis; mitosis intranuclear (with nuclear envelope remaining intact throughout mitosis), with nucleolus persistent and laterally displaced during mitosis; chromosomes tiny and indistinct. Conidiophores simple or infrequently branched and bearing a single terminal conidium per branch. Primary conidia unitunicate, forcibly discharged by papillar eversion. Resting spores typically zygospores formed from conjugations of adjacent cells in hypha or by scalariform conjugations between two hyphae; resting spores formed in axis of parental hypha or conjugation tube. Saprobes in soil or pathogens of insects or other soil invertebrates or desmid algae, or as facultative mycotic agents of vertebrates (including humans).

Type genus: *Ancylistes* Pfitzer

Conidiobolus Brefeld emend. Humber, **emend. nov.**

Mycelium inconspicuous when young; sparse to luxuriant when mature, often infrequently septate; aerial mycelium nonexistent to abundant; vegetative growth always as walled cells; often forming variably shaped hyphal bodies by pinching off or dissociation of intercalary cells devoid of cytoplasm; growing readily on nutritionally simple culture media but unable to utilize nitrate or nitrite. Nuclei 2.5-5 µm in diameter, usually inconspicuous by light microscopy; nucleoplasm with little or no condensed chromatic stainable by aceto-orcein or other chromatin stains; nucleolus central, ovoid; mitotic stages cryptic with light microscopy; mitotic chromosomes tiny, indistinct. Conidiophores simple or (rarely) branched dichotomously, positively phototropic; conidiogenous cells usually undistinguished in diameter or appearance from vegetative hyphae (but occasionally clavate and/or distinctly thicker than vegetative hyphae), with a basal septum, producing a single apical conidium. Primary conidia multinucleate, unitunicate (outer wall layer not separating from conidial surface), pyriform to obovoid or globose; papilla rounded to apiculate; forcibly discharged toward light source by papillar eversion against the conidiogenous cell. Secondary conidia usually with shape of primary conidia but smaller; formed singly on short secondary conidiophore and forcibly discharged toward light source by papillar eversion or ovoid to cylindrical capilliconidia dispersed passively from apices of capillary secondary conidiophores, produced singly from a primary conidium or producing 3+ small, forcibly discharged microconidia on spike-like sterigmata; species capable of forming capilliconidia or microconidia also produce single forcibly discharged secondary conidia; capilliconidia and microconidia never formed by the same species. Rhizoids usually absent; if present, thicker than conidiophores, terminating in a plate-like holdfast, occurring singly, not forming pseudorhizomorphs. Cystidia absent. Resting spores globose, with two thickened wall layers; colorless to cream, yellowish, or amber in mass; zygospores produced inside larger of two (sometimes inconspicuous) conjugating cells, remaining in axis of these cells or only slightly displaced laterally from it at maturity (but not budded laterally through a narrow isthmus); germinating to produce a germ conidiophore and germ conidium or limited germ mycelium with several germ conidiophores; germ conidia resemble primary conidia and are forcibly discharged by papillar eversion. Other resting spore types include chlamydospores (usually irregular in shape, with a single thickened wall layer) or villose conidia (produced by decoration of primary conidial wall with numerous short to long, hair-like appendages). Habit saprobic in soil or decaying plant detritus, facultatively (or possibly obligately) pathogenic for insects or other arthropods, or weakly (facultatively) pathogenic for vertebrates.

Type species: *Conidiobolus utriculosus* Brefeld

This is the family whose membership has been most changed in this revision. *Macrobiotophthora* had been placed in the Entomophthoraceae (Ben-Ze'ev & Kenneth, 1982a; Humber 1984a), but is here reassigned to the Ancylistaceae on the basis of its nuclear cytology which was studied in detail by Tucker (1984). It is also notable that the odd secondary capilliconidia of *Macrobiotophthora vermicola* (Tucker, 1981) are orthotropically attached (Humber, 1984a); the only other entomophthoralean capilliconidia which are so attached are those formed by within the subgenus *Capillidium* of *Conidiobolus*. *Meristacrum*, *Ballocephala*, and *Zygnemomyces* are removed from the Ancylistaceae (Tucker, 1981; Ben-Ze'ev & Kenneth, 1982a; Humber 1984a) to a new family, Meristacraceae, on the basis of their obligately zoophilic habits and formation of multiple conidia on unbranched erect conidiogenous axes.

MERISTACRACEAE Humber, **fam. nov.**

Hyphae vegetativae parietatae coenocyticae primum septatae tandem; cellulae ad septum dissociantes et gametangia aut axes conidiogenas externas serviunt. Nuclei parvi, 3-5 µm diam. per interphasem, nucleolo centrali ovoideo; sine granulis heterochromatis et per "aceto-orcein" vel "Bismarck brown" noncoloratis. Mitoses non vidi autem verosimilter ancylistoides. Axes simplices multiconidiogenae rectae vel torsivae apicale erecte corpore hospitis emergentes. Conidia primaria unitunicata, vehementer eversione papillae basalis aut expulsioni retrorsa protoplasmis celluaris tumidae subconidiae dispersa aut indehiscentia sterigmatibus angustis. Conidia secundaria conidia primaria simulantia expulsa vehementer vel indehiscentia e conidiophoris angustatis aut destitutis. Sporae perdurantes plerumque zygosporae, axiale in cellulis parentalis vel ponticuli conjugentibus scalariformibus conjugationum diclinearum. Species familiae Entomophthoralium pathogeniae obligatae hospites invertebratarum solo, nematodarum tardigradarum praesertim et insectorum raro.

Vegetative growth as walled hyphae in host body, coenocytic at first then becoming septate and cells becoming disjointed, each segment able to give rise to an external hypha bearing conidia or serving as a gametangium for zygosporogenesis. Nuclei small, usually 3-5 µm long during interphase, with prominent central nucleolus; no significant quantity of condensed chromatic granular material in nucleoplasm during interphase, so nuclei not staining strongly with aceto-orcein or Bismarck brown. Nuclei generally difficult to observe; mitosis not observed but assumed to be intranuclear (with nuclear envelope intact throughout mitosis), with nucleolus persistent and laterally displaced during mitosis; chromosomes tiny and indistinct. Conidiophore an unbranched sporogenous axis bearing several conidia. Primary conidia unitunicate, forcibly discharged by papillar eversion, by fluid discharge from swollen lateral cell interposed between conidium and conidiophore, or passively discharged from short sterigmatic extension of conidiophore. Secondary conidia either resembling primary, forcibly discharged; passively dispersed from strongly narrowed, elongate conidiophore; or not formed. Resting spores typically zygospores formed from conjugations of adjacent cells in hypha or by scalariform conjugations between two hyphae; resting spores formed in axis of parental hypha or conjugation tube. Obligately pathogens of soil invertebrates, particularly nematodes and tardigrades, but also possibly insects.

Type genus: *Meristacrum* Drechsler

Other included genera: *Ballocephala* Drechsler, *Zygnemomyces* Miura

NEOZYGITACEAE Ben-Ze'ev & Kenneth in Ben-Ze'ev, Kenneth & Uziel

Vegetative growth as globose to rod-shaped hyphal bodies; cell walls absent or present. Nuclei small, ca. 3-5 µm diameter; nucleolus ovoid, more or less central; condensed chromatin inconspicuous (by light microscopy) during interphase so nuclei stain poorly with aceto-orcein or other nuclear stains; mitoses are synchronous in cell, nuclear envelope remains intact; metaphase spindle occupies entire nuclear volume, and small, vermiform chromosomes are aligned on a conspicuous, central plate. Conidiophores simple, cylindrical to slightly clavate; usually producing terminal conidiogenous cell before conidiogenesis or (rarely) conidia are produced on and discharged from short conidiophores emerging directly from hyphal bodies. Conidia unitunicate, 4 (5) or 7-11 nucleate; papilla truncate or small; discharged (weakly) by papillar eversion; with strong tendency to produce secondary capilliconidia in *Neozygites*. Secondary conidia resembling primary in shape and forcibly discharged by papillar eversion or amygdaliform capilliconidia (usually with terminal mucoid hapteron on short peg-like extension) passively dispersed from capillary conidiophores. All spore types (primary, secondary, and resting) are melanized (pale grey to smoky grey to dark brown of black). Resting spores (zygospores) bud from point of conjugation of two hyphal bodies following round of mitosis in both cells; zygospore receives one nucleus from each gametangium; epispore of mature zygospores strongly melanized and readily detached from endospore; ovoid and smooth surfaced or globose to subglobose and roughened; germinating directly to produce secondary-type capilliconidium on capillary germ conidiophore. Obligately pathogenic for insects (especially Homoptera) and mites.

Type genus: *Neozygites* Witlaczil

BASIDIOBOLACEAE Claussen
in Engler & Gilg

Vegetative growth as regularly septate mycelium with uninucleate cells or as uninucleate yeast form; tending to proliferate by mitosis and plasmotomy inside cell wall ("Darmform" of Levisohn, 1927). Nuclei large, typically longer than 10 µm during interphase, with a prominent central nucleolus; no condensed chromatic granular material obviously present in nucleoplasm during interphase, so nuclei not staining strongly with aceto-orcein or bismarck brown. Nuclei becoming indistinct during mitosis (as nuclear envelope breaks down and nuclear region is surrounded by endoplasmic reticulum); chromosomes tiny, indistinct, and numerous. Conidiophores (if present) simple or infrequently branched with a swollen apex subtending conidium. Primary conidia (if present) unitunicate, uninucleate; forcibly discharged by backward ejection of conidiophore contents upon circumscissile rupture of conidiophore swelling. Resting spores and/or chlamydospores formed in axis of parental hypha; resting spores typically zygospores resulting from fusion of gametangia after formation of short, paired projections which persist on mature spores. Occurring as saprobes in soil, colonizers of guts of amphibia or reptiles, or as facultative mycotic agent in vertebrates (including humans).

Type genus: *Basidiobolus* Eidam

The genera included in the Neozygitaceae, and Basidiobolaceae are unchanged from those previously recognized (Ben-Ze'ev *et al.*, 1986; Ben-Ze'ev & Kenneth, 1982a). The familial descriptions of these and all other families of the Entomophthorales include all of the characters now recognized to be significant.

A second genus can be attributed to the Basidiobolaceae (Humber, 1989). The single species in this still undescribed new genus causes fatal, disseminated mycoses of snakes (Ippen, 1980; Jessup & Seely 1981; Kaplan *et al.*, 1983). An infection of a corn snake originally attributed to a colorless alga, *Prototheca* sp. (Crispens & Marion, 1973), was almost certainly caused by this basidiobolaceous fungus. The fungus grows as a yeast whose globose cells cleave internally to release 2 or 4 cells upon the rupture of the mother cell's wall. Some globose cells may produce an simple or infrequently branched hypha of determinate length. This hypha, which is nearly always uninucleate, usually forms an ovoid intercalary chlamydospore (or zygospore?). Neither forcibly or passively discharged conidia are known from this fungus. Interphasic nuclei are large and have a prominent central nucleolus. As in *Basidiobolus*, the light microscopic image of nuclei of the snake fungus is less distinct during mitosis than during interphase because the nuclear envelope dissociates during mitosis. The spindle fills the nucleus at metaphase, and the small chromosomes are arranged on a central metaphase plate.

The taxonomic changes proposed here represent a further maturation of the phylogenetically based systematics proposed earlier and provide a still greater degree of biological predictability for the classification of the Entomophthorales. The acceptance of generic status for each of the four Batkoan subgenera of *Zoophthora* (Batko, 1966; Ben-Ze'ev & Kenneth, 1982b; Li & Humber, 1984) should remove all remaining differences between the adherents of classifications based on phenetics (Remaudière & Hennebert, 1980; Remaudière & Keller, 1980) or on probable phylogenetic relationships (Humber, 1981, 1982, 1984a; Tucker, 1981; Ben-Ze'ev & Kenneth, 1982a,b). This change should now enable the universal adoption of a single, comprehensive post-Batkoan classification for the Entomophthorales.

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MNEMONIC THREE-LETTER ACRONYMS FOR THE NAMES OF FUNGAL FAMILIES

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In the appendices of this article are listed three-letter abbreviations for the names of 629 families of fungi. This work was inspired by a similar article suggesting standardized three-letter acronyms for the families of vascular plants (Weber 1982). Appendix I lists the families alphabetized according to the full name of the family, while in Appendix II the same information is alphabetized according to the abbreviation.

There are several advantages to such a system of standardized abbreviations. The acronyms can be printed directly on herbarium labels, conveying a considerable amount of taxonomic information in a minimal amount of space. A display containing the codes and their meanings can be posted at conspicuous locations in the herbarium to allow users to interpret the codes rapidly. The abbreviations can also be used to save storage space (and data-entry time) in computerized databases. Programs can easily be written which can translate the abbreviations into full names if the need arises. Standardization of such names will enable workers from different institutions to share information more readily.

As with the listing of plant families, the codes presented here were chosen mnemonically to make rapid memorization and interpretation possible. Many of the codes represent the first three letters of the actual name. In most other cases, they were constructed from the first letter of the name plus two consonants chosen from the other letters in the name.

Compiling the list of currently-used family names proved difficult given the state of flux in which fungal taxonomy finds itself at the present time. Several classification systems are being used by different workers, and new families are still being described rather frequently. The intent here is not to pass judgment on the merits of any particular classification scheme but rather to supply an indexing system useful to mycologists belonging to several schools of thought. The list was compiled primarily from Ainsworth et al. (1973), Bessey (1950), Eriksson & Hawksworth (1987), Jülich (1984), and Alexopoulos (1962), supplemented with information drawn from recent monographs on various taxa. Form-families of Fungi Imperfecti were included in the interests of completeness. Some older families were included under the assumption that these names are still being used by some workers, but very old families which appear to have totally disappeared from use have been omitted.

The original dBase II files containing family names and abbreviations are available from the author for $10.00.

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APPENDIX I: FAMILIES AND ACRONYMS ALPHABETIZED BY FAMILY

Acarosporaceae	ACA
Acetabulaceae	ACE
Achaetomiaceae	ACH
Achlyogetonaceae	ACG
Acrasiaceae	ACR
Acrocordiaceae	ACC
Acrospermaceae	ACS
Actinoplacaceae	ACT
Acytosteliaceae	ACY
Agaricaceae	AGA
Agyriaceae	AGY
Albuginaceae	ALB
Alectoriaceae	ALE
Aleuriaceae	ALR
Aleuriomycetaceae	AMC
Allantosphaeriaceae	ALL
Amanitaceae	AMA
Amauroascaceae	AMR
Amoebidiaceae	AMB
Amorphothecaceae	AMO
Amphisphaeriaceae	AMP
Amylariaceae	AMY
Anapyreniaceae	ANA
Ancylistidaceae	ANC
Anisolpidiaceae	ANI
Antennulariellaceae	ANN
Anthostomataceae	ANT
Anziaceae	ANZ
Aphelariaceae	APH
Aporpiaceae	APO
Arachniaceae	ARA
Arctomiaceae	ARC
Arcyriaceae	ARR
Argynnaceae	ARG
Arthoniaceae	ART
Arthopyreniaceae	ATP
Arthrodermataceae	ADR
Arthrorhapidaceae	ATR
Arundinulaceae	ARU
Ascobolaceae	ASB
Ascocortiaceae	ASC
Ascodichaenaceae	ADC
Ascohymeniaceae	AHM
Ascoideaceae	ASD
Ascosphaeraceae	ASP
Asellariaceae	ASE
Aspergillaceae	APG
Aspidotheliaceae	ATH

Asterinaceae	ASN
Asterothyriaceae	AST
Astraeaceae	ASR
Astrogastraceae	ASG
Astrotheliaceae	ASL
Atichiaceae	ATI
Aulographaceae	AUL
Auriculariaceae	AUR
Auriscalpiaceae	ARS
Bacidiaceae	BCD
Bactrosporaceae	BAC
Baeomycetaceae	BAE
Balsamiaceae	BAL
Bankeraceae	BNK
Basidiobolaceae	BAS
Biatoraceae	BIA
Blastocladiaceae	BLA
Bolbitiaceae	BLB
Boletaceae	BLT
Boliniaceae	BLN
Bondarzewiaceae	BDZ
Botryosphaeriaceae	BOT
Brachybasidiaceae	BRA
Brefeldiellaceae	BFL
Brigantiaeaceae	BRI
Broomeiaceae	BRO
Buelliaceae	BUE
Cainiaceae	CAI
Caliciaceae	CLC
Caloplacaceae	CLP
Calosphaeriaceae	CLS
Calostomataceae	CLT
Calycidiaceae	CAL
Candelariaceae	CND
Cantharellaceae	CNT
Capnodiaceae	CAP
Carbomycetaceae	CAR
Catabotrydaceae	CTB
Catenariaceae	CAT
Catillariaceae	CTL
Cavosteliaceae	CAV
Cephaloascaceae	CPS
Cephalothecaceae	CEP
Ceratiomyxaceae	CMX
Ceratobasidiaceae	CBS
Ceratomycetaceae	CMC
Ceratostomataceae	CST
Chadefaudiellaceae	CDF
Chaetomiaceae	CTM
Chaetothyriaceae	CTT
Chiodectonaceae	CHI
Choanephoraceae	CHO
Chrysotrichaceae	CHR
Chytridiaceae	CHY
Cladochytriaceae	CDC
Cladoniaceae	CLA
Clastodermataceae	CDR

Clathraceae	CTR
Claustulaceae	CSL
Clavariaceae	CVR
Clavariadelphaceae	CDL
Clavicipitaceae	CVC
Clavicoronaceae	CCR
Clavulinaceae	CVL
Clypeosphaeriaceae	CLY
Coccocarpiaceae	CCP
Coccodiniaceae	CDN
Coccoideaceae	CCD
Coccotremataceae	CCT
Cochlonemaceae	CCL
Coelomomycetaceae	COE
Coenogoniaceae	CNG
Coleosporiaceae	CSP
Collemataceae	CLL
Coniochaetaceae	CNC
Coniocybaceae	CON
Coniophoraceae	CNS
Cookellaceae	COO
Coprinaceae	COP
Corneromycetaceae	CMT
Coronophoraceae	CRP
Corticiaceae	CRT
Cortinariaceae	CTN
Coryneliaceae	CRN
Crepidotaceae	CRE
Cribbiaceae	CRB
Cribrariaceae	CRI
Crocyniaceae	CRC
Cronartiaceae	CRO
Cryptococcaceae	CPC
Cryptomycetaceae	CRM
Cucurbitariaceae	CUC
Cunninghamellaceae	CUN
Cyanocephalaceae	CYA
Cypheliaceae	CYP
Cyphellaceae	CPL
Cystobasidiaceae	CYS
Cyttariaceae	CYT
Dacampiaceae	DCM
Dacrymycetaceae	DCR
Dematiaceae	DEM
Dendrosphaeraceae	DND
Dentinaceae	DNT
Dermateaceae	DRM
Dermatocarpaceae	DMC
Dexteriaceae	DEX
Dianemaceae	DNM
Diaporthaceae	DPT
Diatrypaceae	DTP
Dictyopeltinaceae	DPL
Dictyosteliaceae	DIC
Didymiaceae	DID
Didymosphaeriaceae	DDM
Dimargaritaceae	DMG

Dimeriaceae	DMR
Diploschistaceae	DIP
Dipodascaceae	DPD
Discellaceae	DIS
Dothideaceae	DTD
Dothioraceae	DTR
Ecchynaceae	ECN
Eccrinaceae	ECC
Echinodontiaceae	ECD
Echinosteliaceae	ECS
Ectolechiaceae	ELC
Ectrogellaceae	ECG
Eigleriaceae	EIG
Elaeomyxaceae	EMX
Elaphomycetaceae	ELA
Elasmomycetaceae	ESM
Elsinoaceae	ELS
Endochytriaceae	ENC
Endogonaceae	END
Endomycetaceae	EMC
Englerulaceae	ENG
Enteridiaceae	ENR
Entolomataceae	ENL
Entomophthoraceae	ENM
Entophlyctaceae	ENP
Eocronartiaceae	EOC
Eoterfeziaceae	EOT
Ephebaceae	EPH
Eremascaceae	ERE
Eremomycetaceae	ERM
Erysiphaceae	ERY
Euantennariaceae	EUA
Euceratomycetaceae	EUC
Eurotiaceae	EUR
Eurychasmaceae	ERC
Excipulaceae	EXC
Exidiaceae	EXI
Exobasidiaceae	EXO
Fassariaceae	FAS
Favolaschiaceae	FVL
Fenestellaceae	FEN
Filobasidiaceae	FIL
Fimetariaceae	FIM
Fistulinaceae	FIS
Fuckeliaceae	FUC
Fuscideaceae	FUS
Galeropsidaceae	GAL
Ganodermataceae	GAN
Gasterellaceae	GSL
Gastrosporiaceae	GSP
Gautieriaceae	GAU
Geastraceae	GEA
Gelatinodiscaceae	GLT
Gelopellidaceae	GLP
Geneaceae	GEN
Genistellaceae	GNS
Geoglossaceae	GEO
Glaziellaceae	GLZ
Glischrodermataceae	GLI
Gnomoniaceae	GNO
Gomphaceae	GMP
Gomphidiaceae	GOM
Gomphillaceae	GMP
Gonapodyaceae	GON
Graphidaceae	GRD
Graphiolaceae	GRL
Guttulinaceae	GUT
Gyalectaceae	GYA
Gymnoascaceae	GYM
Gyrophoraceae	GYR
Haematommataceae	HAE
Haliphthoraceae	HLP
Halosphaeriaceae	HLS
Haplosporaceae	HPS
Harpellaceae	HAR
Harpidiaceae	HRP
Harpochytriaceae	HCH
Helicocephalidaceae	HCP
Helocarpaceae	HEL
Helotiaceae	HLT
Helvellaceae	HLV
Hemiascaceae	HSC
Hemiascosporiaceae	HMC
Hemigastraceae	HGS
Hemiphacidiaceae	HPC
Hemisphaeriaceae	HMS
Heppiaceae	HEP
Hericiaceae	HRC
Herpomycetaceae	HRM
Herpotrichiellaceae	HPT
Heterodeaceae	HTD
Heteroscyphaceae	HTS
Hoehnelomycetaceae	HOE
Huiliaceae	HUI
Humariaceae	HUM
Hyalographaceae	HLG
Hyaloriaceae	HYA
Hyaloscyphaceae	HLC
Hydnaceae	HDN
Hydnangiaceae	HNG
Hygrophoraceae	HYG
Hymeneliaceae	HML
Hymenochaetaceae	HCT
Hymenogastraceae	HYM
Hyphochytriaceae	HPH
Hypocreaceae	HCR
Hypodermataceae	HDR
Hypogymniaceae	HGM
Hypomycetaceae	HYP
Hyponectriaceae	HNC
Hysterangiaceae	HSG
Hysteriaceae	HYS
Imbricariaceae	IMB
Ixechinaceae	IXE

Jugasporaceae	JGS
Karstenellaceae	KAR
Kickxellaceae	KXL
Koerberiellaceae	KOE
Koralionastetaceae	KOR
Kriegeriellaceae	KRI
Laboulbeniaceae	LBL
Labyrinthulaceae	LBR
Laccariaceae	LCR
Lachnocladiaceae	LAC
Lagenidiaceae	LAG
Lahmiaceae	LAH
Lamprodermaceae	LAM
Lanopilaceae	LNP
Lasiolomataceae	LLM
Lasiosphaeriaceae	LAS
Lecanactidaceae	LEC
Lecanidiaceae	LCN
Lecanoraceae	LNR
Lecideaceae	LCD
Lecidomataceae	LDM
Lecotheciaceae	LCT
Legeriomycetaceae	LEG
Leotiaceae	LEO
Lepiotaceae	LPT
Leptolegniellaceae	LLG
Leptomitaceae	LPM
Leptopeltidaceae	LPL
Leptosphaeriaceae	LSP
Leptostromataceae	LPS
Letrouitiaceae	LET
Leucogastraceae	LEU
Leveillellaceae	LEV
Liceaceae	LIC
Lichenotheliaceae	LTH
Lichinaceae	LCH
Limboriaceae	LIM
Lipomycetaceae	LIP
Lithographaceae	LIT
Lobariaceae	LOB
Lopadiaceae	LPD
Lophiaceae	LPH
Lophiostomataceae	LOP
Lophiotrichaceae	LTR
Lophophytomaceae	LPP
Loramycetaceae	LRM
Lycogalaceae	LGL
Lycoperdaceae	LCP
Macrocystidiaceae	MAC
Marasmiaceae	MAR
Massarinaceae	MAS
Mastodiaceae	MST
Medeolariaceae	MED
Megachytriaceae	MEG
Megalariaceae	MGL
Megalosporaceae	MSR
Melampsoraceae	MLM
Melanconiaceae	MLC
Melanconidaceae	MLD
Melanogastraceae	MGS
Melanommataceae	MLN
Melanosporaceae	MLS
Meliolaceae	MEL
Melogrammataceae	MGR
Meruliaceae	MER
Mesnieraceae	MSN
Mesophelliaceae	MSP
Metacapnodiaceae	MET
Metschnikowiaceae	MKW
Micareaceae	MCR
Microascaceae	MIC
Microglaenaceae	MCG
Micropeltidaceae	MCP
Microtheliopsidaceae	MTL
Microthyriaceae	MTR
Miltideaceae	MIL
Mixiaceae	MIX
Mollisiaceae	MOL
Monascaceae	MNS
Moniliaceae	MNL
Monoblepharidaceae	MBL
Montagneaceae	MNT
Montagnellaceae	MTG
Morchellaceae	MRC
Moriolaceae	MRL
Mortierellaceae	MRT
Mucoraceae	MUC
Munkiellaceae	MNK
Mycenastraceae	MCS
Mycobilimbiaceae	MBB
Mycoblastaceae	MCB
Mycocaliciaceae	MCL
Mycoporaceae	MYC
Mycosphaerellaceae	MSL
Mycotyphaceae	MCT
Myriangiaceae	MYR
Mytilinidiaceae	MYT
Myxotrichaceae	MXT
Nectaromycetaceae	NMC
Nectriaceae	NEC
Nectrioidaceae	NCD
Nematosporaceae	NEM
Neolectaceae	NEO
Nephromataceae	NEP
Nidulariaceae	NID
Nitschkiaceae	NIT
Octavianinaceae	OCT
Odontotremataceae	ODO
Olpidiaceae	OLP
Olpidiopsidaceae	ODP
Omphalotaceae	OMP
Onygenaceae	ONY
Opegraphaceae	OPE
Ophioparmaceae	OPP

Ophiostomataceae	OPH
Oplotheciaceae	OPL
Orbiliaceae	ORB
Orphniosporaceae	ORP
Ostropaceae	OST
Otideaceae	OTI
Pachyascaceae	PCS
Palavasciaceae	PLV
Pannariaceae	PAN
Parataeniellaceae	PTN
Parmeliaceae	PRM
Parmulariaceae	PML
Parodiellaceae	PDL
Parodiopsidaceae	PDP
Paropsidaceae	PPS
Patellariaceae	PAT
Paxillaceae	PXL
Peltigeraceae	PEL
Peltulaceae	PLT
Perichaenaceae	PCH
Pericystaceae	PRC
Peridiaceae	PRD
Perisporiaceae	PRS
Peronophythoraceae	PPT
Peronosporaceae	PRN
Pertusariaceae	PRT
Peyritschiellaceae	PEY
Pezizaceae	PEZ
Phacidiaceae	PHC
Phaeomonomeraceae	PHM
Phaeophragmiaceae	PPG
Phaeosphaeriaceae	PSH
Phaeotrichaceae	PHT
Phallaceae	PHA
Phaneromycetaceae	PNM
Phillipsiellaceae	PHI
Phleogenaceae	PLG
Phlyctidiaceae	PCT
Phragmopelthecaceae	PHR
Phylaciaceae	PHY
Phyllachoraceae	PLC
Phyllobatheliaceae	PLB
Physalaciaceae	PSL
Physaraceae	PSR
Physciaceae	PHS
Physodermataceae	PDR
Physosporellaceae	PSS
Piedraiaceae	PIE
Pilobolaceae	PIL
Pilocarpaceae	PCR
Piptocephalidaceae	PIP
Pisolithaceae	PIS
Pithoascaceae	PIT
Placolecidaceae	PLA
Placynthiaceae	PCN
Plasmodiophoraceae	PMR
Plectascaceae	PLE
Pleomassariaceae	PLM
Pleosporaceae	PLS
Pleurotaceae	PLR
Pluteaceae	PLU
Podaxaceae	PDX
Podoscyphaceae	PDS
Polyporaceae	PLP
Polystigmataceae	PSG
Polystomellaceae	PSM
Polystomellopsidaceae	PSP
Porinaceae	POR
Porpidiaceae	PPD
Protogastraceae	PGS
Protomycetaceae	PMC
Protophallaceae	PPH
Protosteliaceae	PST
Pseudeurotiaceae	PEU
Pseudorhizinaceae	PRZ
Pseudosphaeriaceae	PSE
Pseudovalsaceae	PVL
Psoraceae	PSO
Psorulaceae	PRL
Pterulaceae	PTE
Pucciniaceae	PUC
Punctulariaceae	PUN
Pycnothyriaceae	PYC
Pyrenidiaceae	PND
Pyrenophoraceae	PRP
Pyrenopsidaceae	PNS
Pyrenotrichaceae	PTR
Pyrenulaceae	PNL
Pyronemataceae	PMT
Pythiaceae	PYT
Pyxidiophoraceae	PYX
Radiomycetaceae	RAD
Ramalinaceae	RAM
Rechingeriellaceae	RCG
Requienellaceae	REQ
Reticulariaceae	RMC
Rhipidiaceae	RPD
Rhizidiaceae	RZD
Rhizidiomycetaceae	RZM
Rhizinaceae	RZN
Rhizocarpaceae	RCR
Rhizopogonaceae	RZP
Rhizothyriaceae	RZT
Rhodataceae	RDT
Rhodophyllaceae	RPL
Rhodotorulaceae	RHO
Rhopalosporaceae	RSP
Rhytismataceae	RHY
Richoniellaceae	RIC
Rimulariaceae	RIM
Roccellaceae	ROC
Roccellinastraceae	RLN
Russulaceae	RUS
Saccardiaceae	SRD

Saccardinulaceae	SDN
Saccharomycetaceae	SAC
Saccharomycodaceae	SMD
Saccharomycopsidaceae	SCM
Saksenaeaceae	SAK
Sappiniaceae	SPN
Saprochaetaceae	SPC
Saprolegniaceae	SLG
Sarcoscyphaceae	SSP
Sarcosomataceae	SSM
Sarrameanaceae	SAR
Saturnopichiaceae	SAT
Schadoniaceae	SCH
Schaereriaceae	SCR
Schenellaceae	SCN
Schizophyllaceae	SZP
Schizosaccharomycetaceae	SZS
Schizothriaceae	SZT
Sclerodermataceae	SDR
Sclerophoraceae	SCL
Sclerotiniaceae	STN
Scoliciosporaceae	SCO
Scutigeraceae	SCU
Secotiaceae	SEC
Septobasidiaceae	SEP
Seuratiaceae	SEU
Sirobasidiaceae	SBS
Sirolpidiaceae	SRL
Solorinaceae	SOL
Sordariaceae	SOR
Sparassidaceae	SSD
Spathulosporaceae	SPA
Spermophthoraceae	SMP
Sphaeriaceae	SPH
Sphaerioidaceae	SPD
Sphaerobolaceae	SBL
Sphaerophoraceae	SPR
Sphaerophoropsidaceae	SPP
Sphaeropsidaceae	SPS
Sphinctrinaceae	SCT
Spilomataceae	SPI
Spizellomycetaceae	SPZ
Sporobolomycetaceae	SPB
Sporormiaceae	SRM
Squamarinaceae	SQU
Stegillaceae	SGL
Stemonitaceae	STM
Stephanosporaceae	SSR
Stephanothecaceae	SPT
Stereaceae	STR
Stereocaulaceae	STE
Stictaceae	STC
Stictidaceae	STD
Stigmataceae	SGM
Stigmateaceae	SMT
Stilbaceae	STB
Stilbellaceae	STL
Stomatogenellaceae	SGN
Strigulaceae	STG
Strobilomycetaceae	SBM
Strophariaceae	STP
Syncephalastraceae	SCP
Synchytriaceae	SNC
Syzygosporaceae	SYZ
Taeniellaceae	TAE
Taphrinaceae	TAP
Teloschistaceae	TEL
Tephromelataceae	TEP
Terfeziaceae	TFZ
Testudinaceae	TES
Tetragoniomycetaceae	TET
Thamnidiaceae	THA
Thelebolaceae	TLB
Thelephoraceae	TLP
Thelotremataceae	TLM
Thermoascaceae	TRM
Thielaviascaceae	THV
Thraustochytriaceae	TCH
Thrombiaceae	THR
Thryptosporaceae	TPT
Thyridiaceae	THY
Tilletiaceae	TIL
Torrendiaceae	TRN
Torulopsidaceae	TRL
Trapeliaceae	TRP
Traustochytriaceae	TRA
Tremellaceae	TRE
Tremoleciaceae	TLC
Triblidiaceae	TBD
Trichiaceae	TRC
Trichocomaceae	TCC
Tricholomataceae	TCL
Trichopeltaceae	TPL
Trichopeltidaceae	TPD
Trichopeltinaceae	TPN
Trichosphaeriaceae	TRS
Trichotheliaceae	TTL
Trichothyriaceae	TRI
Triposporiopsidaceae	TSP
Trybilidiaceae	TRB
Trypetheliaceae	TRY
Tuberaceae	TUB
Tuberculariaceae	TBL
Tubeufiaceae	TBF
Tulasnellaceae	TSN
Tulostomataceae	TLS
Umbilicariaceae	UMB
Uredinaceae	URE
Usneaceae	USN
Ustilaginaceae	UST
Valsaceae	VAL
Venturiaceae	VEN
Verrucariaceae	VER
Vezdaeaceae	VEZ

Vialaeaceae	VIA
Vizellaceae	VIZ
Woroninaceae	WOR
Xanthopsorellaceae	XAN
Xerulaceae	XER
Xylariaceae	XYL
Zerovaemycetaceae	ZRV
Zodiomycetaceae	ZOD
Zoopagaceae	ZOO
Zopfiaceae	ZOP
Zythiaceae	ZYT

APPENDIX II: FAMILIES AND ACRONYMS ALPHABETIZED BY ACRONYM

ACA	Acarosporaceae
ACC	Acrocordiaceae
ACE	Acetabulaceae
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ACY	Acytosteliaceae
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AGA	Agaricaceae
AGY	Agyriaceae
AHM	Ascohymeniaceae
ALB	Albuginaceae
ALE	Alectoriaceae
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ALR	Aleuriaceae
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AMP	Amphisphaeriaceae
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ANI	Anisolpidiaceae
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APO	Aporpiaceae
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ASR	Astraeaceae
AST	Asterothyriaceae
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ATR	Arthrorhapidaceae
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BLB	Bolbitiaceae
BLN	Boliniaceae
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BNK	Bankeraceae
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BRA	Brachybasidiaceae
BRI	Brigantiaeaceae
BRO	Broomeiaceae
BUE	Buelliaceae
CAI	Cainiaceae
CAL	Calycidiaceae
CAP	Capnodiaceae
CAR	Carbomycetaceae
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CBS	Ceratobasidiaceae
CCD	Coccoideaceae
CCL	Cochlonemaceae
CCP	Coccocarpiaceae
CCR	Clavicoronaceae
CCT	Coccotremataceae
CDC	Cladochytriaceae
CDF	Chadefaudiellaceae
CDL	Clavariadelphaceae
CDN	Coccodiniaceae
CDR	Clastodermataceae
CEP	Cephalothecaceae
CHI	Chiodectonaceae
CHO	Choanephoraceae
CHR	Chrysotrichaceae

CHY	Chytridiaceae
CLA	Cladoniaceae
CLC	Caliciaceae
CLL	Collemataceae
CLP	Caloplacaceae
CLS	Calosphaeriaceae
CLT	Calostomataceae
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CMX	Ceratiomyxaceae
CNC	Coniochaetaceae
CND	Candelariaceae
CNG	Coenogoniaceae
CNS	Coniophoraceae
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CPL	Cyphellaceae
CPS	Cephaloascaceae
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CRC	Crocyniaceae
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CRI	Cribrariaceae
CRM	Cryptomycetaceae
CRN	Coryneliaceae
CRO	Cronartiaceae
CRP	Coronophoraceae
CRT	Corticiaceae
CSL	Claustulaceae
CSP	Coleosporiaceae
CST	Ceratostomataceae
CTB	Catabotrydaceae
CTL	Catillariaceae
CTM	Chaetomiaceae
CTN	Cortinariaceae
CTR	Clathraceae
CTT	Chaetothyriaceae
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CUN	Cunninghamellaceae
CVC	Clavicipitaceae
CVL	Clavulinaceae
CVR	Clavariaceae
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CYP	Cypheliaceae
CYS	Cystobasidiaceae
CYT	Cyttariaceae
DCM	Dacampiaceae
DCR	Dacrymycetaceae
DDM	Didymosphaeriaceae
DEM	Dematiaceae
DEX	Dexteriaceae
DIC	Dictyosteliaceae
DID	Didymiaceae
DIP	Diploschistaceae
DIS	Discellaceae
DMC	Dermatocarpaceae
DMG	Dimargaritaceae
DMR	Dimeriaceae
DND	Dendrosphaeraceae
DNM	Dianemaceae
DNT	Dentinaceae
DPD	Dipodascaceae
DPL	Dictyopeltinaceae
DPT	Diaporthaceae
DRM	Dermateaceae
DTD	Dothideaceae
DTP	Diatrypaceae
DTR	Dothioraceae
ECC	Eccrinaceae
ECD	Echinodontiaceae
ECG	Ectrogellaceae
ECN	Ecchynaceae
ECS	Echinosteliaceae
EIG	Eigleriaceae
ELA	Elaphomycetaceae
ELC	Ectolechiaceae
ELS	Elsinoaceae
EMC	Endomycetaceae
EMX	Elaeomyxaceae
ENC	Endochytriaceae
END	Endogonaceae
ENG	Englerulaceae
ENL	Entolomataceae
ENM	Entomophthoraceae
ENP	Entophlyctaceae
ENR	Enteridiaceae
EOC	Eocronartiaceae
EOT	Eoterfeziaceae
EPH	Ephebaceae
ERC	Eurychasmaceae
ERE	Eremascaceae
ERM	Eremomycetaceae
ERY	Erysiphaceae
ESM	Elasmomycetaceae
EUA	Euantennariaceae
EUC	Euceratomycetaceae
EUR	Eurotiaceae
EXC	Excipulaceae
EXI	Exidiaceae
EXO	Exobasidiaceae
FAS	Fassariaceae
FEN	Fenestellaceae
FIL	Filobasidiaceae
FIM	Fimetariaceae
FIS	Fistulinaceae
FUC	Fuckeliaceae
FUS	Fuscideaceae
FVL	Favolaschiaceae
GAL	Galeropsidaceae
GAN	Ganodermataceae

GAU	Gautieriaceae
GEA	Geastraceae
GEN	Geneaceae
GEO	Geoglossaceae
GLI	Glischrodermataceae
GLP	Gelopellidaceae
GLT	Gelatinodiscaceae
GLZ	Glaziellaceae
GMP	Gomphaceae
GMP	Gomphillaceae
GNO	Gnomoniaceae
GNS	Genistellaceae
GOM	Gomphidiaceae
GON	Gonapodyaceae
GRD	Graphidaceae
GRL	Graphiolaceae
GSL	Gasterellaceae
GSP	Gastrosporiaceae
GUT	Guttulinaceae
GYA	Gyalectaceae
GYM	Gymnoascaceae
GYR	Gyrophoraceae
HAE	Haematommataceae
HAR	Harpellaceae
HCH	Harpochytriaceae
HCP	Helicocephalidaceae
HCR	Hypocreaceae
HCT	Hymenochaetaceae
HDN	Hydnaceae
HDR	Hypodermataceae
HEL	Helocarpaceae
HEP	Heppiaceae
HGM	Hypogymniaceae
HGS	Hemigastraceae
HLC	Hyaloscyphaceae
HLG	Hyalographaceae
HLP	Haliphthoraceae
HLS	Halosphaeriaceae
HLT	Helotiaceae
HLV	Helvellaceae
HMC	Hemiascosporiaceae
HML	Hymeneliaceae
HMS	Hemisphaeriaceae
HNC	Hyponectriaceae
HNG	Hydnangiaceae
HOE	Hoehnelomycetaceae
HPC	Hemiphacidiaceae
HPH	Hyphochytriaceae
HPS	Haplosporaceae
HPT	Herpotrichiellaceae
HRC	Hericiaceae
HRM	Herpomycetaceae
HRP	Harpidiaceae
HSC	Hemiascaceae
HSG	Hysterangiaceae
HTD	Heterodeaceae
HTS	Heteroscyphaceae
HUI	Huiliaceae
HUM	Humariaceae
HYA	Hyaloriaceae
HYG	Hygrophoraceae
HYM	Hymenogastraceae
HYP	Hypomycetaceae
HYS	Hysteriaceae
IMB	Imbricariaceae
IXE	Ixechinaceae
JGS	Jugasporaceae
KAR	Karstenellaceae
KOE	Koerberiellaceae
KOR	Koralionastetaceae
KRI	Kriegeriellaceae
KXL	Kickxellaceae
LAC	Lachnocladiaceae
LAG	Lagenidiaceae
LAH	Lahmiaceae
LAM	Lamprodermaceae
LAS	Lasiosphaeriaceae
LBL	Laboulbeniaceae
LBR	Labyrinthulaceae
LCD	Lecideaceae
LCH	Lichinaceae
LCN	Lecanidiaceae
LCP	Lycoperdaceae
LCR	Laccariaceae
LCT	Lecotheciaceae
LDM	Lecidomataceae
LEC	Lecanactidaceae
LEG	Legeriomycetaceae
LEO	Leotiaceae
LET	Letrouitiaceae
LEU	Leucogastraceae
LEV	Leveillellaceae
LGL	Lycogalaceae
LIC	Liceaceae
LIM	Limboriaceae
LIP	Lipomycetaceae
LIT	Lithographaceae
LLG	Leptolegniellaceae
LLM	Lasiolomataceae
LNP	Lanopilaceae
LNR	Lecanoraceae
LOB	Lobariaceae
LOP	Lophiostomataceae
LPD	Lopadiaceae
LPH	Lophiaceae
LPL	Leptopeltidaceae
LPM	Leptomitaceae
LPP	Lophophytomaceae
LPS	Leptostromataceae
LPT	Lepiotaceae
LRM	Loramycetaceae
LSP	Leptosphaeriaceae
LTH	Lichenotheliaceae
LTR	Lophiotrichaceae

MAC	Macrocystidiaceae
MAR	Marasmiaceae
MAS	Massarinaceae
MBB	Mycobilimbiaceae
MBL	Monoblepharidaceae
MCB	Mycoblastaceae
MCG	Microglaenaceae
MCL	Mycocaliciaceae
MCP	Micropeltidaceae
MCR	Micareaceae
MCS	Mycenastraceae
MCT	Mycotyphaceae
MED	Medeolariaceae
MEG	Megachytriaceae
MEL	Meliolaceae
MER	Meruliaceae
MET	Metacapnodiaceae
MGL	Megalariaceae
MGR	Melogrammataceae
MGS	Melanogastraceae
MIC	Microascaceae
MIL	Miltideaceae
MIX	Mixiaceae
MKW	Metschnikowiaceae
MLC	Melanconiaceae
MLD	Melanconidaceae
MLM	Melampsoraceae
MLN	Melanommataceae
MLS	Melanosporaceae
MNK	Munkiellaceae
MNL	Moniliaceae
MNS	Monascaceae
MNT	Montagneaceae
MOL	Mollisiaceae
MRC	Morchellaceae
MRL	Moriolaceae
MRT	Mortierellaceae
MSL	Mycosphaerellaceae
MSN	Mesnieraceae
MSP	Mesophelliaceae
MSR	Megalosporaceae
MST	Mastodiaceae
MTG	Montagnellaceae
MTL	Microtheliopsidaceae
MTR	Microthyriaceae
MUC	Mucoraceae
MXT	Myxotrichaceae
MYC	Mycoporaceae
MYR	Myriangiaceae
MYT	Mytilinidiaceae
NCD	Nectrioidaceae
NEC	Nectriaceae
NEM	Nematosporaceae
NEO	Neolectaceae
NEP	Nephromataceae
NID	Nidulariaceae
NIT	Nitschkiaceae
NMC	Nectaromycetaceae
OCT	Octavianinaceae
ODO	Odontotremataceae
ODP	Olpidiopsidaceae
OLP	Olpidiaceae
OMP	Omphalotaceae
ONY	Onygenaceae
OPE	Opegraphaceae
OPH	Ophiostomataceae
OPL	Oplotheciaceae
OPP	Ophioparmaceae
ORB	Orbiliaceae
ORP	Orphniosporaceae
OST	Ostropaceae
OTI	Otideaceae
PAN	Pannariaceae
PAT	Patellariaceae
PCH	Perichaenaceae
PCN	Placynthiaceae
PCR	Pilocarpaceae
PCS	Pachyascaceae
PCT	Phlyctidiaceae
PDL	Parodiellaceae
PDP	Parodiopsidaceae
PDR	Physodermataceae
PDS	Podoscyphaceae
PDX	Podaxaceae
PEL	Peltigeraceae
PEU	Pseudeurotiaceae
PEY	Peyritschiellaceae
PEZ	Pezizaceae
PGS	Protogastraceae
PHA	Phallaceae
PHC	Phacidiaceae
PHI	Phillipsiellaceae
PHM	Phaeomonomeraceae
PHR	Phragmopelthecaceae
PHS	Physciaceae
PHT	Phaeotrichaceae
PHY	Phylaciaceae
PIE	Piedraiaceae
PIL	Pilobolaceae
PIP	Piptocephalidaceae
PIS	Pisolithaceae
PIT	Pithoascaceae
PLA	Placolecidaceae
PLB	Phyllobatheliaceae
PLC	Phyllachoraceae
PLE	Plectascaceae
PLG	Phleogenaceae
PLM	Pleomassariaceae
PLP	Polyporaceae
PLR	Pleurotaceae
PLS	Pleosporaceae
PLT	Peltulaceae
PLU	Pluteaceae
PLV	Palavasciaceae

PMC	Protomycetaceae
PML	Parmulariaceae
PMR	Plasmodiophoraceae
PMT	Pyronemataceae
PND	Pyrenidiaceae
PNL	Pyrenulaceae
PNM	Phaneromycetaceae
PNS	Pyrenopsidaceae
POR	Porinaceae
PPD	Porpidiaceae
PPG	Phaeophragmiaceae
PPH	Protophallaceae
PPS	Paropsidaceae
PPT	Peronophythoraceae
PRC	Pericystaceae
PRD	Peridiaceae
PRL	Psorulaceae
PRM	Parmeliaceae
PRN	Peronosporaceae
PRP	Pyrenophoraceae
PRS	Perisporiaceae
PRT	Pertusariaceae
PRZ	Pseudorhizinaceae
PSE	Pseudosphaeriaceae
PSG	Polystigmataceae
PSH	Phaeosphaeriaceae
PSL	Physalaciaceae
PSM	Polystomellaceae
PSO	Psoraceae
PSP	Polystomellopsidaceae
PSR	Physaraceae
PSS	Physosporellaceae
PST	Protosteliaceae
PTE	Pterulaceae
PTN	Parataeniellaceae
PTR	Pyrenotrichaceae
PUC	Pucciniaceae
PUN	Punctulariaceae
PVL	Pseudovalsaceae
PXL	Paxillaceae
PYC	Pycnothyriaceae
PYT	Pythiaceae
PYX	Pyxidiophoraceae
RAD	Radiomycetaceae
RAM	Ramalinaceae
RCG	Rechingeriellaceae
RCR	Rhizocarpaceae
RDT	Rhodataceae
REQ	Requienellaceae
RHO	Rhodotorulaceae
RHY	Rhytismataceae
RIC	Richoniellaceae
RIM	Rimulariaceae
RLN	Roccellinastraceae
RMC	Reticulariaceae
ROC	Roccellaceae
RPD	Rhipidiaceae
RPL	Rhodophyllaceae
RSP	Rhopalosporaceae
RUS	Russulaceae
RZD	Rhizidiaceae
RZM	Rhizidiomycetaceae
RZN	Rhizinaceae
RZP	Rhizopogonaceae
RZT	Rhizothyriaceae
SAC	Saccharomycetaceae
SAK	Saksenaeaceae
SAR	Sarrameanaceae
SAT	Saturnopichiaceae
SBL	Sphaerobolaceae
SBM	Strobilomycetaceae
SBS	Sirobasidiaceae
SCH	Schadoniaceae
SCL	Sclerophoraceae
SCM	Saccharomycopsidaceae
SCN	Schenellaceae
SCO	Scoliciosporaceae
SCP	Syncephalastraceae
SCR	Schaereriaceae
SCT	Sphinctrinaceae
SCU	Scutigeraceae
SDN	Saccardinulaceae
SDR	Sclerodermataceae
SEC	Secotiaceae
SEP	Septobasidiaceae
SEU	Seuratiaceae
SGL	Stegillaceae
SGM	Stigmataceae
SGN	Stomatogenellaceae
SLG	Saprolegniaceae
SMD	Saccharomycodaceae
SMP	Spermophthoraceae
SMT	Stigmateaceae
SNC	Synchytriaceae
SOL	Solorinaceae
SOR	Sordariaceae
SPA	Spathulosporaceae
SPB	Sporobolomycetaceae
SPC	Saprochaetaceae
SPD	Sphaerioidaceae
SPH	Sphaeriaceae
SPI	Spilomataceae
SPN	Sappiniaceae
SPP	Sphaerophoropsidaceae
SPR	Sphaerophoraceae
SPS	Sphaeropsidaceae
SPT	Stephanothecaceae
SPZ	Spizellomycetaceae
SQU	Squamarinaceae
SRD	Saccardiaceae
SRL	Sirolpidiaceae
SRM	Sporormiaceae
SSD	Sparassidaceae
SSM	Sarcosomataceae

SSP	Sarcoscyphaceae
SSR	Stephanosporaceae
STB	Stilbaceae
STC	Stictaceae
STD	Stictidaceae
STE	Stereocaulaceae
STG	Strigulaceae
STL	Stilbellaceae
STM	Stemonitaceae
STN	Sclerotiniaceae
STP	Strophariaceae
STR	Stereaceae
SYZ	Syzygosporaceae
SZP	Schizophyllaceae
SZS	Schizosaccharomycetaceae
SZT	Schizothriaceae
TAE	Taeniellaceae
TAP	Taphrinaceae
TBD	Triblidiaceae
TBF	Tubeufiaceae
TBL	Tuberculariaceae
TCC	Trichocomaceae
TCH	Thraustochytriaceae
TCL	Tricholomataceae
TEL	Teloschistaceae
TEP	Tephromelataceae
TES	Testudinaceae
TET	Tetragoniomycetaceae
TFZ	Terfeziaceae
THA	Thamnidiaceae
THR	Thrombiaceae
THV	Thielaviascaceae
THY	Thyridiaceae
TIL	Tilletiaceae
TLB	Thelebolaceae
TLC	Tremoleciaceae
TLM	Thelotremataceae
TLP	Thelephoraceae
TLS	Tulostomataceae
TPD	Trichopeltidaceae
TPL	Trichopeltaceae
TPN	Trichopeltinaceae
TPT	Thryptosporaceae
TRA	Traustochytriaceae
TRB	Trybilidiaceae
TRC	Trichiaceae
TRE	Tremellaceae
TRI	Trichothyriaceae
TRL	Torulopsidaceae
TRM	Thermoascaceae
TRN	Torrendiaceae
TRP	Trapeliaceae
TRS	Trichosphaeriaceae
TRY	Trypetheliaceae
TSN	Tulasnellaceae
TSP	Triposporiopsidaceae
TTL	Trichotheliaceae
TUB	Tuberaceae
UMB	Umbilicariaceae
URE	Uredinaceae
USN	Usneaceae
UST	Ustillaginaceae
VAL	Valsaceae
VEN	Venturiaceae
VER	Verrucariaceae
VEZ	Vezdaeaceae
VIA	Vialaeaceae
VIZ	Vizellaceae
WOR	Woroninaceae
XAN	Xanthopsorellaceae
XER	Xerulaceae
XYL	Xylariaceae
ZOD	Zodiomycetaceae
ZOO	Zoopagaceae
ZOP	Zopfiaceae
ZRV	Zerovaemycetaceae
ZYT	Zythiaceae

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CANALISPORIUM, A NEW GENUS OF LIGNICOLOUS HYPHOMYCETES FROM MALAYSIA

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Canalisporium gen.nov. is erected to accommodate **Berkleasmium caribense** and **B.pulchrum.** **Canalisporium elegans** sp.nov. is described as the third species in the genus.

Holubová-Jechová & Mercado (1984) described two new species of **Berkleasmium** Zobel, namely **B.caribense** Hol.-Jech. & Mercado and **B.pulchrum** Hol.-Jech. & Mercado occurring on dead branches from Cuba. Both species produce colonies that are sporodochial, punctiform, pulvinate, black and shining. Their conidia are flattened dorsiventrally, comprising a single layer of regularly arranged cells, supported by a small, thinner-walled, cuneiform, lighter-coloured basal cell. Conidia of **B.caribense** possess a single longitudinal septum with 3 – 6 equally spaced transverse septa, while in **B.pulchrum** there are two longitudinal septa and 4 – 6 transverse septa. **B.caribense** has since been recorded from Kenya (Kirk, 1985), Uganda and Taiwan (Matsushima, 1987). In recording their occurrence both authors commented that **B.caribense** is not closely related to **Berkleasmium. B.pulchrum** has also been recorded from Kenya (Kirk, 1985) and India (Rao & Hoog, 1986).

Recent collections of submerged decaying wood and bark from a freshwater stream, subsequently incubated in moist chambers have yielded **B.caribense, B.pulchrum** and an undescribed species. Having had the opportunity of examining authentic specimens of **B.caribense** (PRM 831526) and **B.pulchrum** (PRM 831528) kindly supplied by Dr. Holubová-Jechová and the collections of Dr. Kirk from Kenya (**B.caribense** IMI 284792a and **B.pulchrum** IMI 285428a), Rao from India (**B.pulchrum** CBS-H 3852) and Dr. Matsushima from Taiwan (**B.caribense** MFC-6T 811), we are of the opinion that none of these collections are closely related to **Berkleasmium** and that a new genus is required to accommodate them.

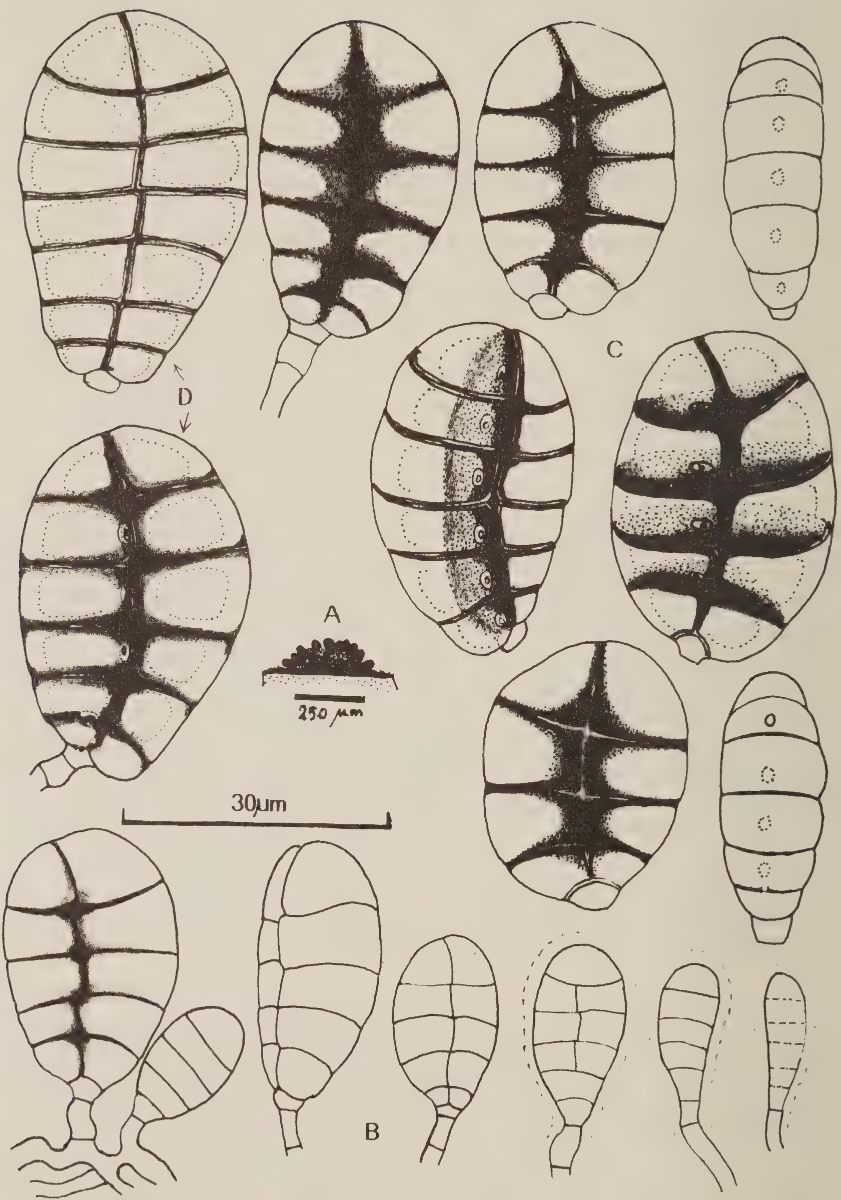


Fig.1. **Canalisporium caribense.** A, habit sketch; B, stages in conidium formation arranged in a developmental series from bark; C, conidia in surface and side view; D, two conidia from the holotype material (PRM 831526).

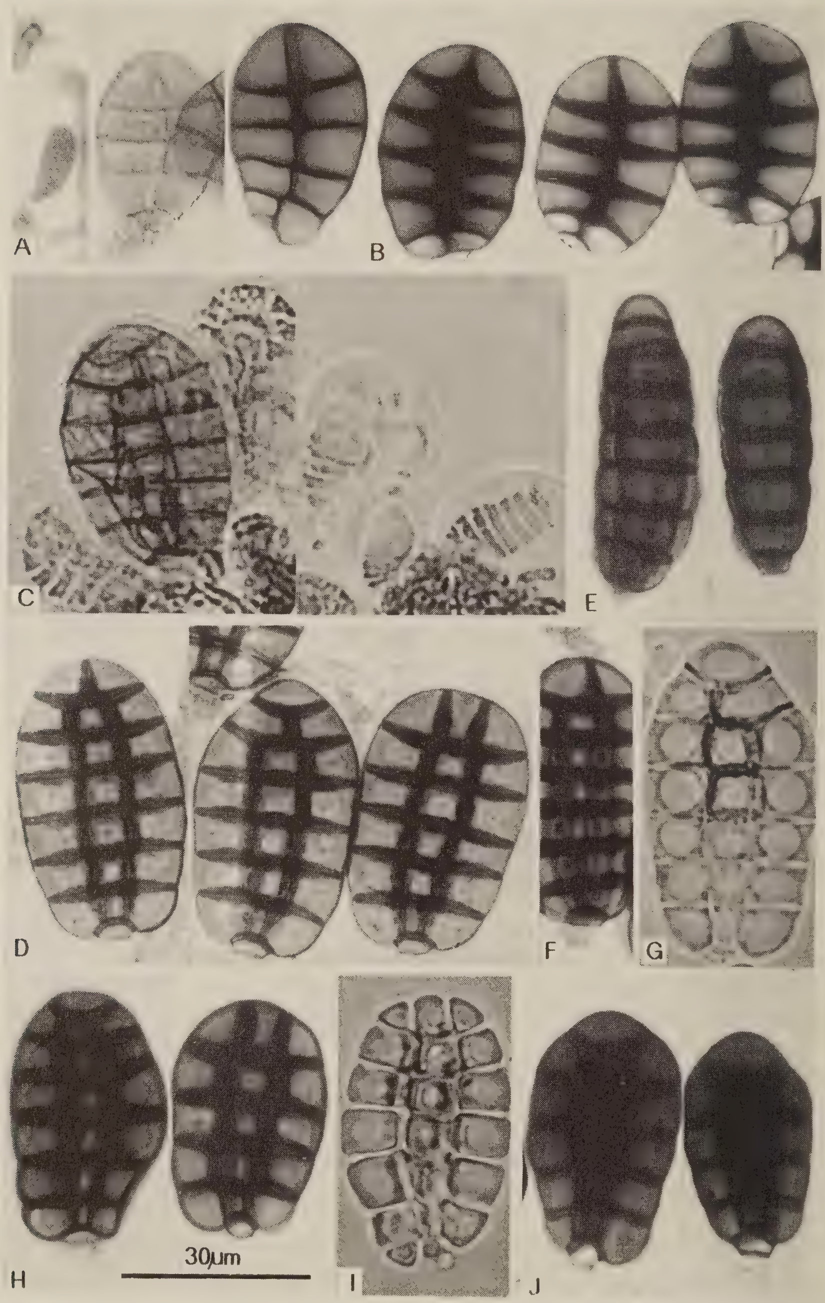
B.concinnum(Berk.) S.Hughes the type species of **Berkleasmium** has well formed stromata and its conidia are distinctly cylindrical with numerous cells that are randomly arranged and without well spaced transverse and longitudinal septa. The conidia often lack a basal cell, but instead possess a protruding hilum. Developmentally the conidia of **B.concinnum** "originate as blown-out hyphal ends, and reach nearly the size of mature conidia before septation is initiated" (Goos, 1969). Conidial maturation is by meristematic growth of the entire conidium and secession is apparently rhexolytic. These differences merit separation at the generic level.

Canalisporium Nawawi and Kuthubutheen gen.nov.

Sporodochia dispersa, punctiformia, pulvinata, atra, nitida. Mycelium in substrato immersum, ex hyphis ramosis, septatis, laevibus, pallide brunneis vel brunneis compositum. Stromata nulla vel rudimenta. Conidiophora semi-macronemata vel macronemata, mononemata, fasciculata, simplicia vel parce ramosa, subhyalina vel pallidissima brunnea, leavia, septata. Cellulae conidiogenae in conidiophoris incorporatae, terminales, determinatae. Conidiorum secessio schizolytica. Conidia acrogena, solitaria, late ellipsoidea, obpyriformia vel subglobosa, complanata, muriformia, olivaceo-brunnea, rubrobrunnea vel atrobrunnea, laevia, cum septis transversis et longitudinalis, atris, crassis praedita; cellula basalia cuneiformia, fere tenuitunicata, subhyalina vel pallidissima brunnea. Lumina cellularum canaliculis tenuibus, pigmento apposito connexa.

Species typica: **Berkleasmium caribense** Hol.-Jech. & Mercado. **Česká Mykologie 38:** 89 (1984).

Sporodochia scattered, punctiform, pulvinate, granular, black, shining. **Mycelium** mostly immersed in the substratum, composed of branched, septate, smooth, pale brown to brown hyphae. **Stromata** none or rudimentary. **Conidiophores** semi-macronematous to macronematous, mononematous, fasciculate, simple to sparsely branched, subhyaline to pale brown, smooth, septate. **Conidiogenous cells** integrated, terminal, determinate, cylindrical, sometimes swollen. **Conidial secession** schizolytic. **Conidia** acrogenous, solitary, broadly ellipsoidal, obpyriform to subglobose, flattened, muriform, olivaceous brown, brown, reddish brown to dark brown, smooth, with dark, thick-walled transverse and longitudinal septa; basal cell cuneiform, thinner-walled, subhyaline to light brown. Cell lumen connected by narrow canals each surrounded by a marked ring of pigmentation, barrel-shaped in side view.


A
B
C
E
D
F
G
H
30µm
I
J

Canalisporium caribense (Hol.-Jech. & Mercado) Nawawi & Kuthubutheen comb.nov.

Figs. 1 – 2

Berkleasmium caribense Hol.-Jech. & Mercado. **Česká Mykologie 38:** 99, 1984 (basionmy).

Sporodochia on the bark scattered, punctiform, pulvinate, granular, black, shining, up to 200 µm diam. **Mycelium** mostly submerged in the substratum, composed of irregularly branched, septate, smooth subhyaline to pale brown hyphae 1.5 – 2.5 µm wide. **Stromata** none or rudimentary consisting of irregularly branched, short, intertwined hyphae. **Conidiophores** semi-macronematous to macronematous, mononematous, fasciculate, erect to ascending, unbranched to sparsely branched, hyaline to subhyaline, smooth up to 20 µm long x 2 – 3.5 µm wide. **Conidiogenous cells** integrated, terminal, determinate, cylindrical or swollen. **Conidial secession** schizolytic. **Conidia** acrogenous, solitary, flattened, one-cell thick, smooth, thick-walled, broadly ellipsoidal to obovoid in surface view, fusiform to obclavate in lateral view, muriform, with a single, slightly curved longitudinal septum and from 3 – 6 straight transverse septa, slightly constricted at the septa, evenly brown to reddish dark brown, 28 – 41 x 21 – 28 wide x 10 – 14 µm. Basal cell subhyaline to pale brown, cuneiform, with thinner wall, 5 – 5.5. long x 3 – 3.5 µm wide. Septa becoming progressively darker with conidial maturity. The left and right cell lumen are connected by narrow canals, each surrounded by a marked ring of pigmentation, visible in surface view as a circular disc 2 – 2.5 µm diam, barrel-shaped in side view. Canals are also present in the transverse septa, but only on one side of the conidium adjacent to the curved side of the longitudinal septum.

Specimen examined: On submerged decaying bark, Gombak Field Study Centre, Selangor, Malaysia, 12 Sept., 1987, A. Nawawi, IMI 326601.

Fig.2. A – B, **Canalisporium caribense.** A, three stages in conidium formation and maturation from bark; B, mature conidia. C – J, **Canalisporium pulchrum.** C, several developing conidia enveloped in mucilage; D, three conidia in surface view; E, two conidia in side view with the connecting pores clearly visible; F, part of a conidium showing pores along the longitudinal septa; G, a bleached conidium; H – I, conidia from the holotype material, one bleached (PRM 831528); J, two conidia from the Indian collection (CBS-H 3852).

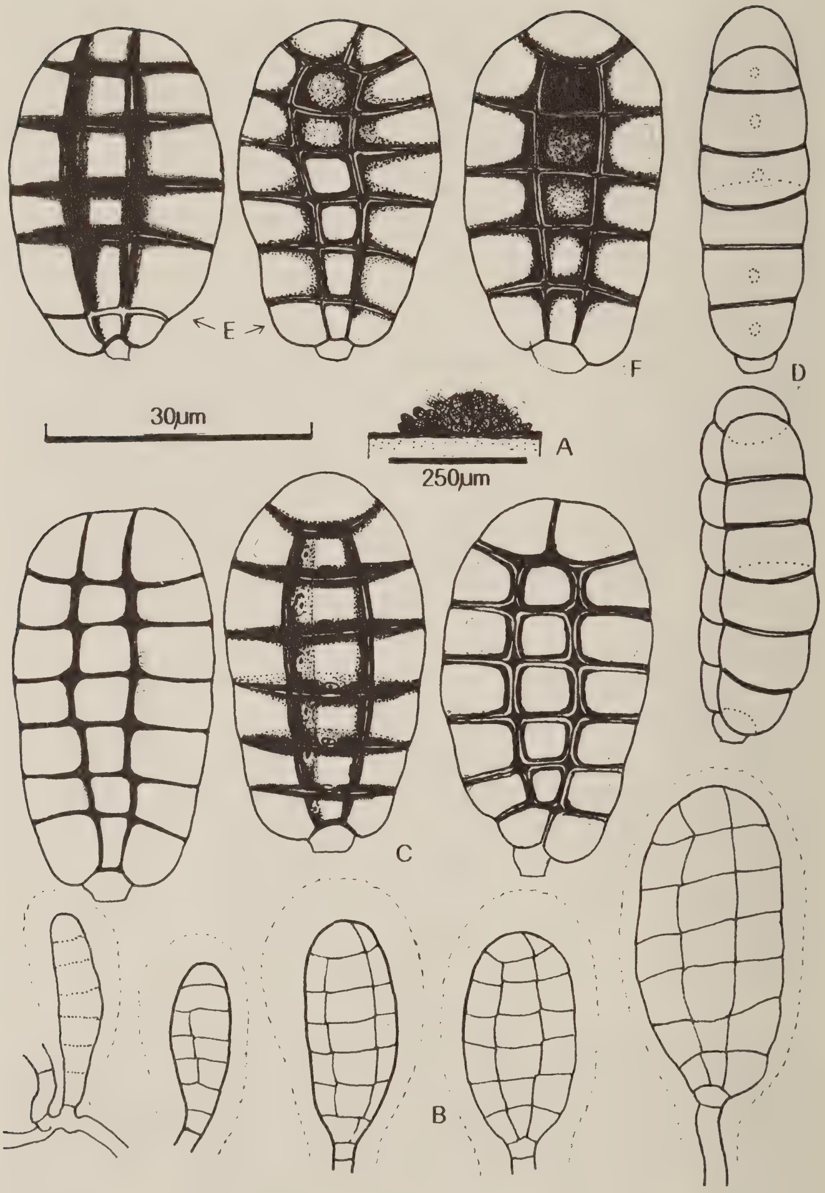


Fig.3. **Canalisporium pulchrum.** A, habit sketch; B, stages in conidium formation from bark; C – C, conidia in surface and side view; E, two conidia from the holotype material (PRM 831528); F, a conidium from the Indian collection (CBS-H 3852).

Conidia germinate very slowly on agar media by the production of a germ tube from the basal cell. On CMA linear extension of the hyphae is limited, and colonies from a single conidium, after 4 weeks at 25 – 27°C consist of a compact mass of hyphae rarely exceeding 8 mm in diam. The colonies are at first hyaline, progressively turning grey and finally black with most of the hyphae becoming moniloid. Sporulation was sparse on CMA, but occurred profusely on strips of sterilised banana leaves overlying CMA. Sporodochia are similar to those formed on the bark, but tend to coalesce to form an extensive mass of conidia.

Conidial development from bark and on banana leaves is similar. Conidia originate as a blown-out hyphal ends, at first hyaline and club-shaped. Cross septa develop quite early followed by the formation of longitudinal septa. Development of pigmentation occurs soon after all the septa have been formed and becomes more intense as the conidia age.

Comparative studies made on the holotype material from Cuba and those collected by Kirk from Kenya with the Malaysian isolate show that there is no fundamental difference in conidial morphology, size and in the number of cells making up a conidium. Conidia from the holotype material, however, appear to be slightly reddish brown with less pigmentation and hence the connective pores are readily visible.

Canalisporium pulchrum (Hol.-Jech. & Mercado) Nawawi & Kuthubutheen comb.nov.

Figs. 2 – 3

Berkleasmium pulchrum Hol.-Jech. & Mercado. **Česká Mykologie 38:** 96 – 120. 1984 (basionym)

Sporodochia scattered, punctiform, pulvinate, granular, black, shining, circular to ellipsoidal, up to 300 µm diam. **Mycelium** scanty, mostly immersed in the substratum composed of branched, smooth, septate, pale olivaceous brown to brown hyphae 2 – 3.5 µm wide. **Stromata** absent or at most rudimentary, consisting of much-branched intertwined hyphae. **Conidiophores** semi-macronematous, mononematous, fasciculate, densely aggregated, simple or sparsely branched, short, septate, pale brown, smooth, up to 20 µm high, 2.5 – 4 µm wide. **Conidiogenous cells** integrated, terminal, determinate. **Conidial secession** schizolytic. Conidia arising as terminal blown out ends of conidiogenous cells, initially club-shaped and hyaline, each surrounded by a thick layer of mucilage. Transverse septa formed early in development, followed by longitudinal septa, at first thin-walled, progressively becoming thicker and darker and finally heavily pigmented. **Conidia** acrogenous, solitary, broadly ellipsoidal in surface view, clavate in lateral view, muriform, one-cell thick, smooth, evenly olivaceous brown to brown, slightly constricted at the septa, 36 – 55 x 22 – 27 x 12 – 15 µm. Basal cell thinner-walled, lighter, cuneiform, 5 – 6 µm long x 4 – 5 µm wide. Longitudinal septa with narrow, barrel-shaped pores, 1.5 – 2 µm diam connecting each cell lumen laterally; transverse septa with pores only in the middle column of cells.

Specimen examined. On rotten wood, Gombak Field Study Centre, Selangor, Malaysia 20 Oct. 1987, A. Nawawi, IMI 326602.

Conidia germinate slowly on agar by producing a germ tube from the basal cell. On CMA the colonies are dark, restricted, with little aerial mycelium, attaining a diam of 10 mm in 4 weeks at 25 – 27°C. Sporulation was sparse on agar but occurred profusely on strips of sterilised banana leaves overlying CMA. Conidia formed on agar are slightly smaller but otherwise resemble those formed on the natural substratum.

Comparative studies on conidial morphology, size, colour, septation and the number of cells making up a conidium between the holotype material from Cuba and those collected from India and Malaysia are listed in Table 1.

Table 1. Comparison of **Canalisporium pulchrum** from three localities

Locality	Conidial size (µm)	No. of transverse septa	No. of cells/ conidium	No. of cells in apical row
Cuba	27-43x23-27x12-15 (36x25)*	3-6	13-21	1-3
India	28-50x20-29x15-17 (41-25)	3-6	11-20	mostly 1
Malaysia	36-52x22-27x12-15 (44x24)	4-7	14-24	1-3

* Figures in brackets are average length x width.

While there is no significant difference in conidial morphology and width between the 3 collections, their lengths vary slightly. The Malaysian collection has longer conidia, less pigmented septa, and contains more cells per conidium. In other

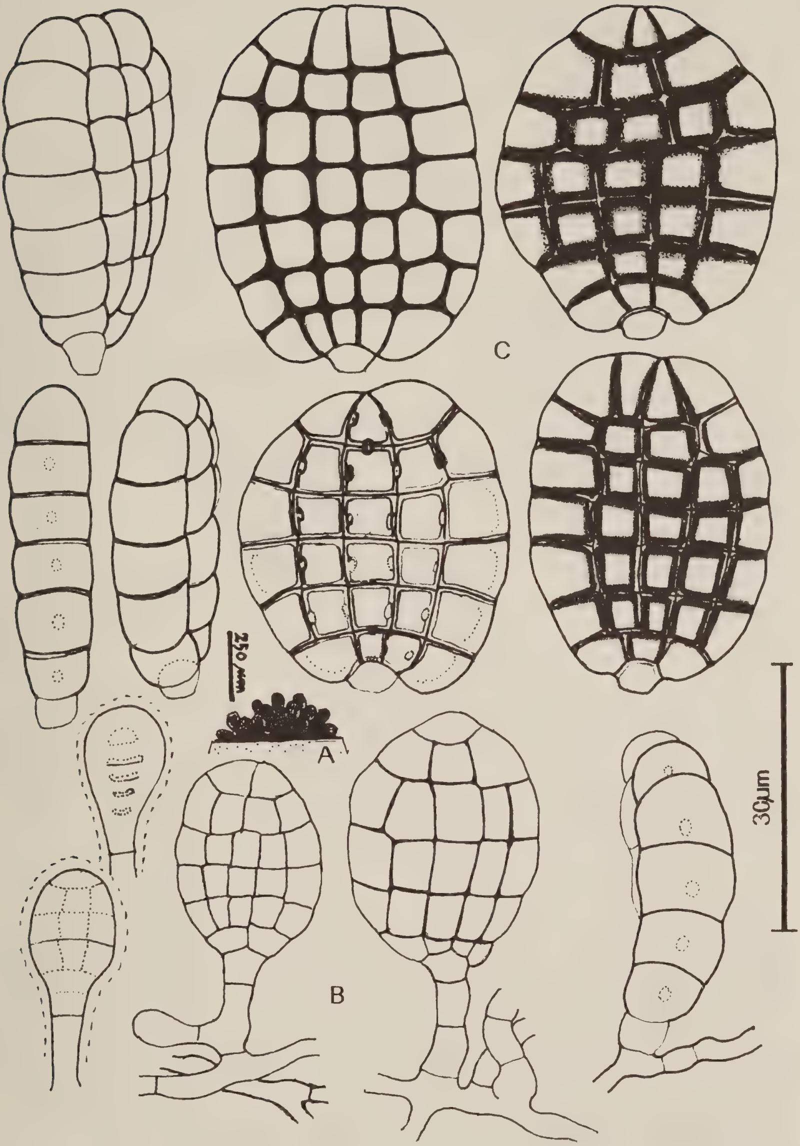

C
250 µm
A
B
30µm

Fig.4. **Canalisporium elegans.** A, habit sketch; B, stages in conidium formation from bark; C, conidia in surface and side view.

aspects it is very similar to the holotype material. Conidia of the Indian collection are darker, heavily pigmented and the majority possess only one cell in the apical row.

Collection from Kenya (IMI 285428a) Fig. 5

The collection from Kenya which Kirk (1985) identified as **Berkleasmium pulchrum** appears to be quite different. The conidia are broadly obpyriform and significantly larger, measuring 34 – 56 x 27 – 34 x 15 – 18 µm (avg. 48 x 30 µm), reddish brown to brown with 5 – 7 transverse septa that are heavily pigmented. The number of cells per conidium varies from 17 – 19. The most obvious difference is the absence of a basal cell. Instead, a row of three, smaller, subhyaline cells is present, joined to the conidiophore and conidial secession appears to be rhexolytic. These differences have been pointed out by Rao & Hoog (1986). A further study of conidiogenesis is necessary before any reclassification is proposed.

Canalisporium elegans Nawawi & Kuthubutheen sp.nov. Figs. 4 – 5

Sporodochia dispersa, punctiformia, atra, nitida, usque ad 250 µm diam. Mycelium in substrato immersum, ex hyphis ramosis, septatis, laevibus, pallide brunneis, 2 – 3.5 µm latis compositum. Stromata nulla. Conidiophora semi-macronemata, mononemata, fasciculata, simplicia vel parce ramosa, subhyalina vel pallidissima brunnea, laevia, septata, usque ad 15 µm longa x 3 – 4 µm crassa. Cellulae conidiogenae in conidiophoris incorporatae, terminales. Conidiorum secessio schizolytica. Conidia acrogena, solitaria, subglobosa, complanata, muriformia, olivacea brunnea vel brunnea, laevia, 32 – 47 x 27 – 35 x 10 – 13 µm, cum 5 – 7 septis transversis et 4 (-5) septis longitudinalibus, atris, crassis praedita; cellula basali cuneiformia, fere tenuitunicata, subhyalina, 5– 6 µm longa x 4 – 5 µm crassa. Lumina cellularum canaliculis tenuibus, pigmento apposito connexa, 1.5 – 2 µm diam.

Ex ramo putrido deiecto trunci ignoti, Gombak Field Study Centre, Selangor, Malaysia 20 oct. 1987, A. Nawawi, IMI 326603, holotypus.

Sporodochia scattered, punctiform, pulvinate, granular, black, shining, up to 250 µm in diam. **Mycelium** mostly immersed in the substratum, composed of branched, septate smooth, pale brown, 2 – 3.5 µm wide hyphae. **Stromata** none. **Conidiophores** semi-macronematous, mononematous, fasciculate, simple to sparsely branched, subhyaline to pale brown, up to 15 µm long x 3 – 4 µm wide. **Conidiogenous cells** integrated, terminal,

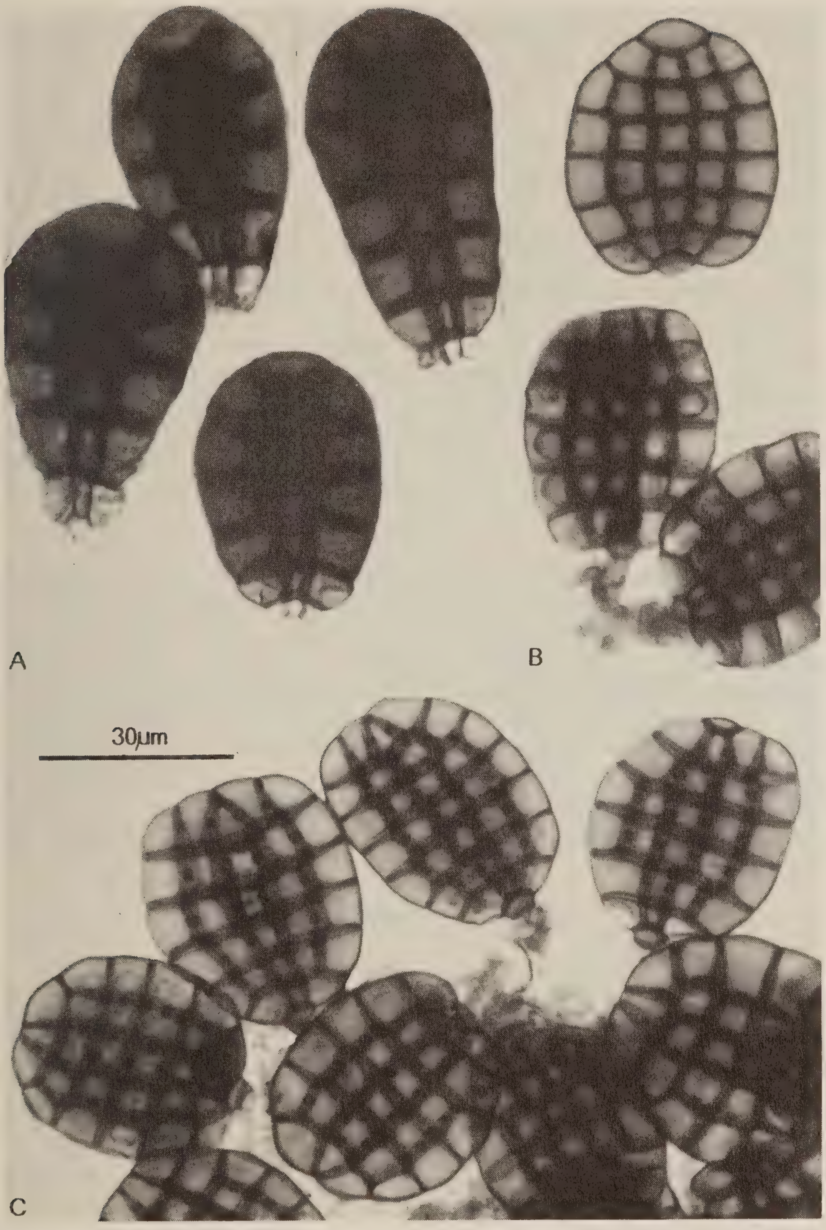


Fig.5. A, four conidia from the Kenyan collection (IMI 285428a); B – C, **Canalisporium elegans.** Mature conidia from bark.

determinate. **Conidial secession** schizolytic. **Conidia** acrogenous, solitary, subglobose, flattened, one-cell thick, muriform, smooth, olivaceous brown to brown, 32 – 47 x 27 – 35 x 10 – 13 µm with dark, thick-walled 5 – 7 transverse septa and 4 (-5) longitudinal septa; basal cell cuneiform, 4 – 6 µm long x 4 – 5 µm wide, thinner-walled, subhyaline. The number of cells per conidium varies from 26 – 35, apical row with 1 – 5 cells. Cell lumina connected by narrow canals, 1.5 – 2 µm diam, each surrounded by a marked ring of pigmentation. Along the transverse septa, canals are only present in the middle column of cells.

Conidia germinate slowly on agar by producing a germ tube from the basal cell. Colonies are slow growing, restricted, at first grey but eventually turning dark, attaining a diam of 12 mm in 4 weeks at 25 – 27°C. Sporulation was poor on agar but occurred profusely on strips of sterilised banana leaf overlying CMA. Conidia formed in cultures are slightly smaller, many with only 3 longitudinal septa.

The three species of **Canalisporium** described above have several characters in common. They are all lignicolous with black, punctiform, non-stromatic sporodochia. Conidiophores and conidiogenesis are similar. Their conidia are muriform, complanate, generally brown with transverse and longitudinal septa that are highly pigmented. The basal cell is distinct and is delimited from the spore body in pigmentation, size and thickness of cell wall. The pore-like connectives of conidial lumina are remarkable in all three species. Conidial germination is by a basal germ-tube and their colonies are dark, slow growing and restricted.

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The authors are much obliged to Professor J. Webster for kindly reviewing the manuscript and to Drs. V. Holubova-Jechova, G.S.de Hoog, P.M. Kirk, T. Matsushima and the herbarium of CMI for the loan of collections mentioned in the text.

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QUADRICLADIUM AQUATICUM GEN. ET SP.NOV., AN AQUATIC HYPHOMYCETE WITH TETRARADIATE CONIDIA

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Quadricladium aquaticum gen. et sp.nov., an aquatic hyphomycete with hyaline, tetraradiate conidia from submerged decaying bark is described and illustrated. The generic characters are briefly compared with those of somewhat similar genera: **Lemonniera, Tetraposporium, Brachiosphaera** and **Flabellospora.**

The existence of large, hyaline, pearly, tetraradiate conidia in foam samples from fresh streams in Malaysia has been known to the senior author since 1975, but the identity of the fungus forming these conidia remained undetermined, as it has never been detected on its natural substrata and details of conidiogenesis were unknown. Repeated attempts to germinate and establish the fungus in pure culture were unsuccessful. A recent collection of submerged decaying bark pieces from a fresh water stream has yielded the fungus in question. Having now successfully observed the fungus developing on its natural substrate and conidial development in pure culture, we are of the opinion that it does not fit into any known taxa. A new genus is erected to accommodate it.

Quadricladium gen.nov.

Coloniae effusae, hyalinae, inconspicuae. Mycelium plerumque superficiale, ex hyphis laevibus, ramosis, septatis, hyalinis compositum. Conidiophora macronemata, mononemata, solitaria, erecta, simplicia, recta vel leviter flexuosa, laevia, septata, hyalina. Cellulae conidiogenae in conidiophoris incorporatae, terminales. Proliferatio holoblastica et sympodialis. Conidia acrogena, solitaria, hyalina, tetraradiata, septata; axis principalis cum conidiophoris continuis; ramis lateralis 3 – 4, simul gemmantia. Conidiorum secessio schizolytica.

Species typica **Quadricladium aquaticum** sp.nov.

Colonies effuse, hyaline, inconspicuous. Mycelium mostly superficial, composed of branched, smooth, septate, hyaline hyphae. Conidiophores macronematous, mononematous, solitary, erect, simple, straight to slightly flexuous to slightly flexuous, smooth, septate, hyaline. Condiogenous cells incorporated in the conidiophores, terminal. Proliferation holoblastic and sympodial. Conidia acrogenous, solitary, hyaline, septate, tetraradiate; principal arm continuous with the conidiophores; lateral arms 3 – 4, produced simultaneously. Conidial secession schizolytic.

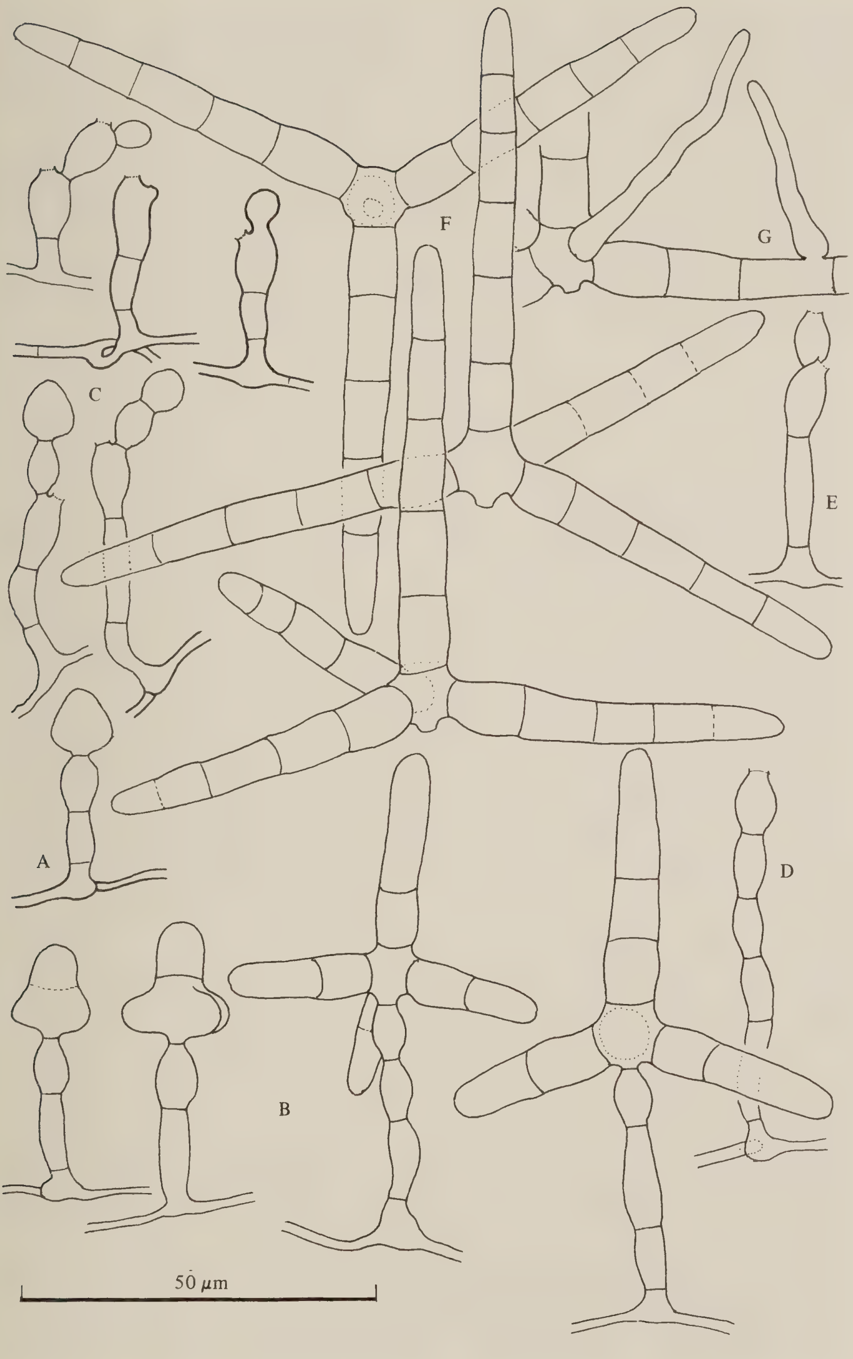
Quadricladium aquaticum sp.nov. Figs. 1 – 2

Coloniae effusae, hyalinae, inconspicuae. Mycelium plerumque superficiale, ex hyphis laevibus, ramosis, septatis, hyalina, 1.5 – 2.5 µm latis compositum. Conidiophora macronemata, mononemata, solitaria, erecta, recta vel leviter flexuosa, interdum leviter geniculata, laevia, 1 – 5 septata, hyalina, 16 – 58 µm alta x 3– 4 µm lata. Cellulae conidiogenae in conidiophoris incorporatae, subglobosa vel ellipsoidea, 8 – 10 µm x 4.5 – 6 µm, terminales. Proliferatio holoblastica et sympodialis. Conidia acrogena, solitaria, hyalina, tetraradiata; parte centralis subglobosa 9 – 12 µm in diam cum conidiophoris connexa, cum uno axe et 3 – (4) ramis divergentibus, simul gemmantia. Rami et axis leviter constricti ad basim, 41 – 67 µm longi x 6.5 – 7.5 µm lati, 3 – 6 septati. Conidiorum secessio schizolytica.

Habitat saprophytice in cortice decidui trunci in flumine immersi, Mimaland, Selangor, Malaysia, 27 Julii, 1988, A. Nawawi, IMI 327415 holotypus.

This fungus was found growing and sporulating on pieces of decaying bark taken from a submerged log of an unidentified tree in a small fresh water stream at Mimaland, Selangor. On incubation at 25 – 27°C in water this fungus sporulated for several days. Conidiophores bearing conidia were formed under water and also on the moist exposed parts of the substratum.

Fig. 1. **Quadricladium aquaticum.** A – B, Stages in conidium formation on bark arranged in a developmental series; C – E, conidiophores showing detachment scars and proliferation; F, three typical conidia, one viewed from below; G, part of a conidium showing germ tubes.


C
F
G
E
A
B
D
50 μm

Colonies effuse, hyaline, inconspicuous. Mycelium mostly superficial, composed of smooth, branched, septate, hyaline hyphae 1.5 – 2.5 µm wide. Conidiophores macronematous, mononematous, solitary, simple, erect, straight to slightly flexuous, sometimes geniculate, 16 – 58 µm long x 3 – 4 µm wide, smooth, 1 – 5 septate, hyaline. Conidiogenous cells integrated, terminal, broadly ellipsoidal to ovoid, 8 – 10 µm long x 4.5 – 6 µm wide. Proliferation holoblastic and sympodial. Conidial development on the bark begins with the formation of a small spherical swelling at the apex of the conidiogenous cell. This swelling is soon delimited by a septum, elongates slightly, becomes tetrahedral and 2-celled. The four arms of the conidium develop simultaneously from the corners of the tetrahedron, one arm always distal and continuous with the conidiophores, the others radiating outwardly forming an angle of 100 – 120° with the distal arm. The distal arm elongates slightly faster than the others and is usually longer in mature conidia. Septa are formed as the arms elongate. When a conidium reaches maturity, another conidiogenous cell develops very close to the attachment point and soon produces another conidium. This process of sympodial proliferation is repeated 3 – 4 times. Conidial secession is schizolytic. The conidia, if undisturbed, often remain attached to their respective conidiogenous cells. A small, circular, collarette-like scar is clearly visible on the conidiogenous cell after each conidium is released. Mature detached conidia are tetraradiate, occasionally pentaradiate hyaline, pearly, with a globose to pentagonal central cell 9 – 12 µm in diam; attachment scar distinct in side view as a conicotruncate protuberance 2 µm wide. Arms straight, cylindrical, tapering only slightly, 41 – 67 µm long x 6.5 – 7.5 µm at the widest and 3 µm at the rounded apex, narrowing slightly at the base. Septa thin-walled, but distinct, up to 6 per arm.

Conidia germinate with difficulty. On CMA germination occurred after 4 days at 25 – 27°C. Germ tubes are produced from the apical cells or anywhere along the arms including the central cell. Colonies are slow growing, white, ciruclar with a slight mound, attaining a diam of 10 mm in 30 days; reverse concolorous. Aerial mycelium compact, hyphae hyaline 1.5 – 2.5 µm wide, occasionally forming spherical structures 3 – 4 µm diam terminally or intercalarily. No sporulation occurred on dry agar but when strips of the colony were suspended in water conidia were formed abundantly. The pattern of conidial formation is

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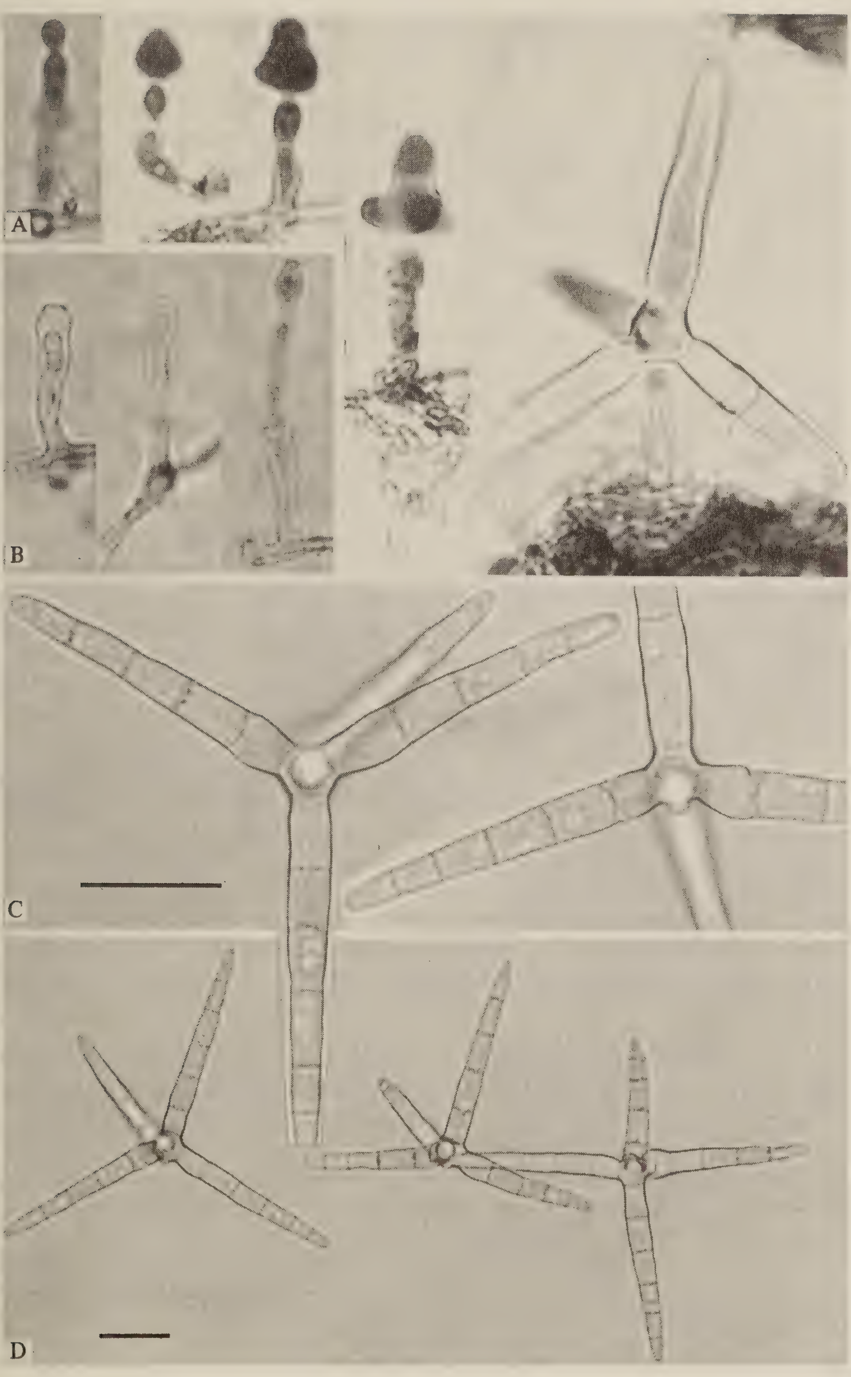
Fig. 2. **Quadricladium aquaticum.** A, States in conidium formation from bark; B, conidiophores with spent conidiogenous cells; C – D, typical conidia. Bars = 20 µm.


A
B
C
D

similar to those formed on the natural substratum. Conidia, however, tend to be slightly smaller in size.

Conidia of **Q.aquaticum** are very similar to those of the aquatic hyphomycete **Lemonniera** de Wild., particularly **L.terrestris** Tubaki. However, members of **Lemonniera** produce their conidia on distinct phialides borne on long, often branched conidiophores and are widespread in temperate countries (Descals, Webster & Dyko, 1977). The anamorph genus is apparently not represented in Malaysia (Nawawi, 1985).

Another genus which produces conidia with similar conidial morphology and configuration to the present fungus is **Tetraposporium** Hughes, but members of this genus are dematiaceous and are hyperparasites (Hughes, 1951). Their conidia are borne on very short, determinate conidiophores, often undifferentiated from the vegetative hyphae.

In terms of conidiogenesis, shape and proliferation of the conidiogenous cells, **Q.aquaticum** is similar to **Brachiosphaera tropicalis** Nawawi, a common aquatic hyphomycete occurring on submerged decaying branches and twigs. Its conidia are abundant in foam samples from Malaysian fresh water streams and widely distributed in the tropics (Descals, Nawawi & Webster, 1976). However, conidia of **B.tropicalis** possess a large, spherical central cell from which the 4 septate arms radiate out. **Q.aquaticum** has also been considered for inclusion in **Flabellospora** Alasoadura. The type species **F.crassa** Alasoadura (1968), a rather common aquatic hyphomycete in Malaysia, has hyaline, septate, tetraradiate conidia with a globose, pedunculate central axis from which the obclavate arms radiate out simultaneously. Conidia are borne on long, undifferentiated, determinate conidiophores with drooping conidiogenous cells. The arms of the conidia are constricted at their points of origin and conidial secession is by a break in the constriction along the drooping peduncle.

A leaf-litter hyphomycete described by Matsushima (1981) from Alabama, U.S.A. as **Flabellospora irregularis** Matsushima produces conidia with 2 – 4 arms radiating simultaneously from a globose, central cell. Conidia are produced on short conidiophores and the ovoid conidiogenous cells proliferate sympodially, very similar to **Q.aquaticum.** In recording its occurrence the author commented that **F.irregularis** deviates somewhat from other members of the genus in its conidial morphology. This fungus has also been recorded from Taiwan (Matsushima, 1983), and is perhaps congeneric with **Q.aquaticum.**

Professor J. Webster of Exeter University continues to be the subject of our thanks for his prepublication editorial vetting of this manuscript.

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A NEW TAXON IN COLISPORA (HYPHOMYCETES) FROM MALAYSIA

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Colispora curvata sp.nov., an aquatic hyphomycete from submerged decaying petioles is described and illustrated.

Staurosporous species are the classic representatives of Ingoldian fungi, but scolecosporous forms are also present. A number of didymo- and phragmosporous aquatic species have been described, all assigned to characteristically terrestrial anamorph-genera. Two such examples are **Pyricularia aquatica** Ingold (1943) with a **Massarina** teleomorphic stage (Webster, 1965) and **P.submersa** Ingold (1944). Both were transferred to **Dactylella** Grove, respectively as **D.aquatica** (Ingold) Ranzoni (1953) and **D.submersa** (Ingold) Nilsson (1962). Their inclusion in either **Pyricularia** or **Dactylella** is still debatable.

An aquatic hyphomycete resembling **P.submersa** in conidiogenesis and spore morphology, found on pieces of submerged decaying petioles from a freshwater stream at the University of Malaya Field Study Centre in 1976 was left undescribed. The senior author was not convinced that it should be placed in either **Pyricularia** or **Dactylella.** Recently Marvanova (1988) erected a new genus of aquatic hyphomycete with a single species, **Colispora elongata** Marvanova, isolated from foam in Czechoslovakia with similar characteristics as our undescribed fungus, and this is described below as a new species in the genus.

Colispora curvata sp.nov. Figs. 1 – 2

Coloniae effusae, hyalinae, inconspicuae. Mycelium partim superficiale, partim in substrato immersum, ex hyphis laevibus, ramosis, septatis, hyalinis, 1.5 – 2.5 µm latis compositum. Conidiophora micronematosa vel semi-macronematosa, mononemata, solitaria, simplicia, recta, laevia, septata, hyalina, usque ad 185 µm longa, 2.5 – 3.5 µm lata, per usque ad 20 proliferationes percurrentes crescentia. Cellulae conidiogenae in conidiophoris incorporatae, terminales, percurrentes. Conidiorum secessio schizolytica. Proliferatio enteroblastica et percurrens progressiv et annulos fingens. Conidia acrogena, solitaria, reniformia, guttulata, hyalina, laevia, 2 – 3 septata, ad apice rotundata, basi conico-truncata, excentrica, 25 – 38 (-59) µm longa, 7.5 – 10 µm lata, 3 – 4 ad basim.

Ex petiolis angiospermis putrescentibus in flumine immersi, University of Malaya Field Study Centre, Gombak, Selangor, Malaysia, 3 Aug. 1976, A. Nawawi, IMI 327693 holotypus.

Colonies on the petioles effuse, hyaline, inconspicuous. Mycelium partly superficial, partly immersed in the substratum, composed of smooth, branched, septate, hyaline hyphae 1.5 – 2.5 µm wide. Conidiophores micronematous to semi-macronematous, mononematous, solitary, simple, straight, smooth, septate, hyaline, up to 185 µm long, 2.5 – 3.5 µm wide, with up to 20 or more percurrent proliferations. Conidiogenous cells integrated, terminal, percurrent. Conidial secession schizolytic. Proliferation enteroblastic, percurrent and progressive, leading to the formation of annellations. Conidia acrogenous, solitary, reniform, guttulate, 2 – 3 septate, rounded at the apex with an eccentric conico-truncate base, hyaline, smooth, rich in glycogen, pearly, 25 – 38 (-59) µm long, 7.5 – 10 µm wide, 3 – 4 µm at the base.

The course of an individual conidium development on the natural substrate was followed in a constant flow chamber containing a small piece of the colonised petiole as described by Descals, Nawawi & Webster (1976). The conidium starts as a small, oval swelling at the end of the conidiophore. It elongates, swells considerably, becomes slightly curved and is cut off by a cross wall. A septum soon develops near the middle. The rounded apex continues to elongate and another septum develops. In the meantime several guttules of various sizes appear, rendering the conidium pearly and foamy. It takes about 7 – 8 hr for a conidium to mature and become detached. As soon as a conidium is released, the truncate conidiophore tip resumes growth, proceeds for 5 – 9 µm before producing the next conidium at a higher level. This process is repeated many times and results in a conidiophore of up to 480 µm long. Annellations on the conidiophore are not always prominent as they are thin, and colourless. They appear as a faint, transverse band across the broadest part of the beaded portion along the conidiophore. In old conidiophores a series of these annellations occurs, numbering up to 20.

Conidia germinate soon after their release. On 2% MA the colony is at first white, turning greyish with several concentric

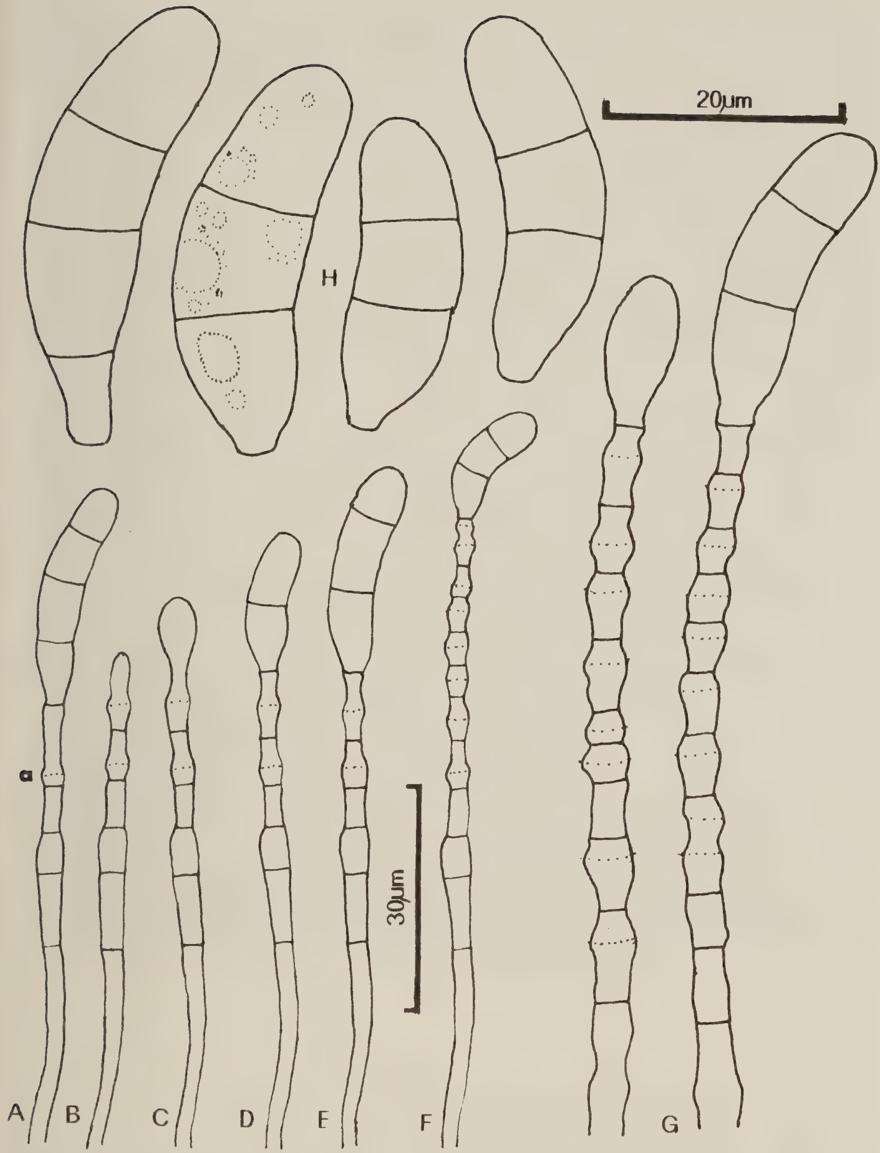

Fig.1. **Colispora curvata.** A – E, a conidiophore drawn at intervals over a period of 10 hr in a constant flow chamber showing the manner of conidium development. The conidiophore had previously produced a conidium at the point A; F, the same conidiophore 48 hr later; G, two conidiophores with developing conidia; H, typical conidia from petiole.

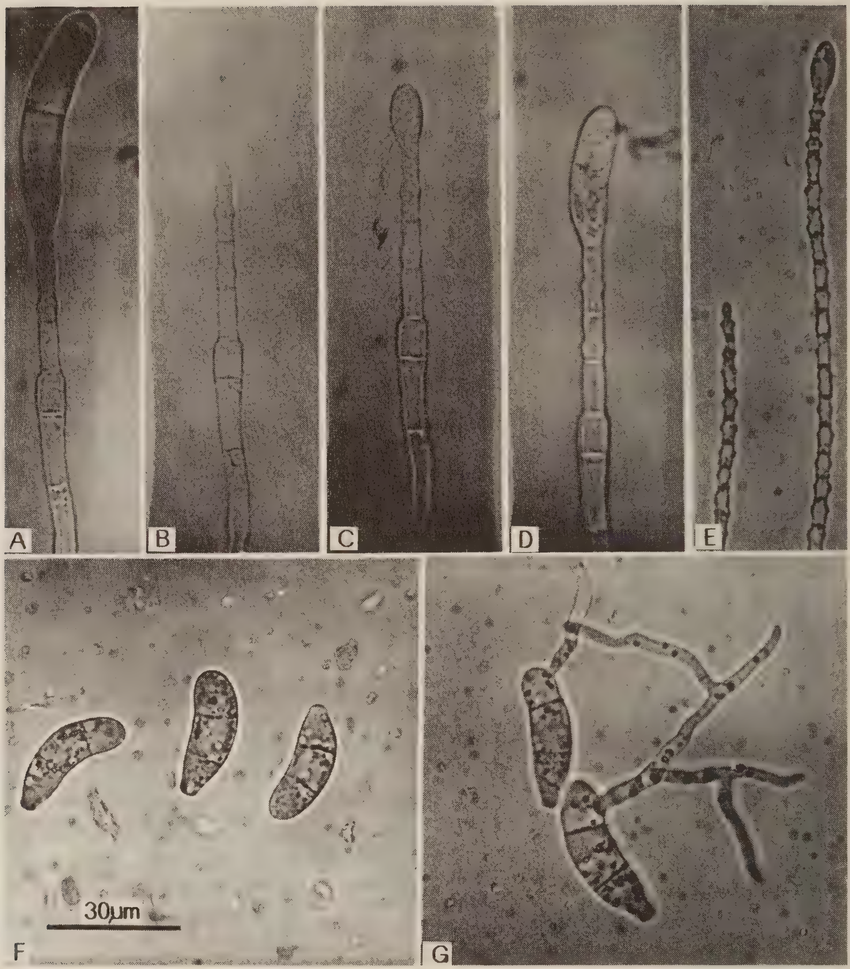

Fig.2. **Colispora curvata.** A – D, a conidiophore showing four stages in conidium formation. F – G, conidia and germination.

zones; aerial mycelium fluffy, reverse concolorous, attaining a diam of 22 mm in 14 days at 25 – 28°C. Sporulation was sparse on dry agar, but occurred profusely on strips of agar submerged in sterile water. It was observed that aeration is essential for normal spore formation. Unaerated cultures tend to produce conidia that are longer, many with 3 septa.

C.curvata is essentially similar to **C.elongata** and **P.submersa** in conidiogenesis and proliferation of their conidiophores and in having hyaline, septate, pearly conidia. Conidia of **C.elongata** and **P.submersa** however, are longer, fusiod to clavate mostly straight and with more septa. Colonies on 2% MA were described as dark-grey and greenish-grey respectively.

We are grateful to Professor J. Webster, University of Exeter, for kindly reviewing the manuscript and for helpful comments.

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MYCOTAXON

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ASCOMYCETES OF WESTERN INDIA XIII

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The paper communicates 2 new species of bitunicate Ascomycetes viz. Didymella capparidis sp.nov. and Julella multiloculata sp.nov.

Didymella capparidis sp.nov. (Fig. 1-4)

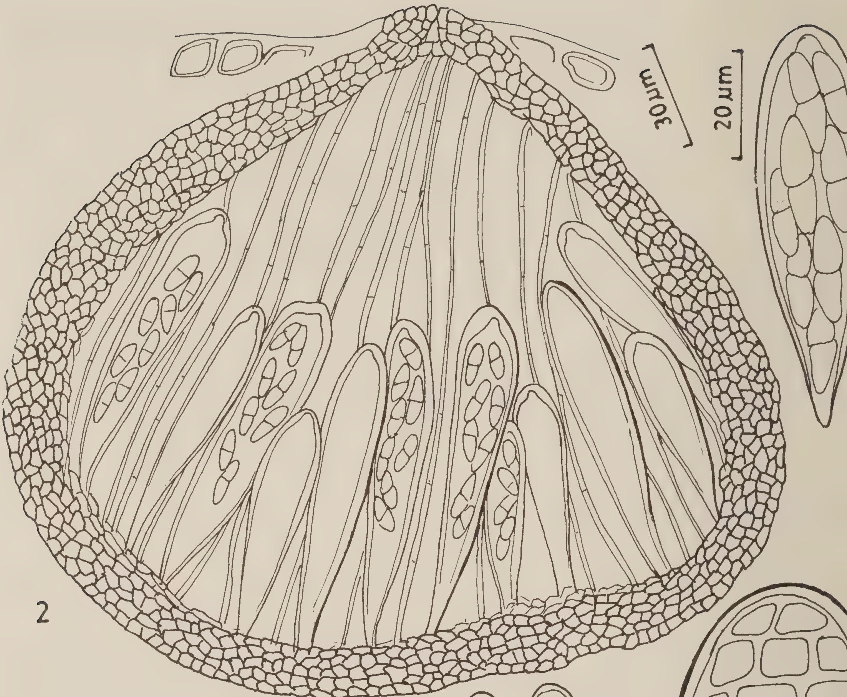
Stroma immersed in the bark, appearing as shining black areas through split bark, upto 5 mm long, 2-3 mm wide and 100-200 µm deep. Ascocarps separate or aggregated, immersed in stroma, globose to subglobose, slightly papillate, 110-180 x 160-200 µm. Wall composed of thick-walled polygonal, brown cells. Asci in basal layers, surrounded by pseudoparaphyses, bitunicate, clavate, shortly stalked or nearly sessile, 60-90 x 14-18 µm. Ascospores hyaline, 1-septate, elliptical, tips rounded, constricted at septum; 27-32 x 6-10 µm.

Collected on dead twigs of Capparis horida L.f. at Pune (Maharashtra) 9.X.1981. AMH 7153 (Holotype).

Stromata anthracina, immersa in corticem 5 mm longa, 2-3 mm lata, 100-200 um crassa, exposita per corticem. Ascomata depressa, immersa, numerosa, ovoidea-globosa, leviter papillata, magnit. 110-180 x 160-200 µm. Paries compositae ex cellulae polygonae, atrobrunneae. Asci basalis, paraphysoidibus, bitunicati, clavati, brevistipitati, 60-90 x 14-18 µm. Ascosporae hyalinae, ellipticae, apicem rotundato, uniseptatae, constrictae ad septum, 27-32 x 6-10 µm.

Ad caulibus mortuis Capparis horida L.f. dt. 9.X.1981. Loco: Pune. (Maharashtra). AMH 7153 (Holotypus).

There is only one stromatic species under the genus Didymella viz. D. stromatica Barr & Rogerson (1982). However, the ascomata, asci and ascospores in that species are much smaller and also the ascospores in D. stromatica are obovoid with obtuse apical end and more acute basal tip, whereas in the present collection they are elliptical and rounded at both ends. It is described here as a new species, the specific epithet being derived from the host genus.



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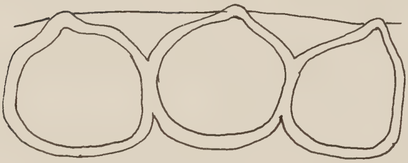

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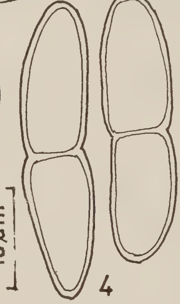

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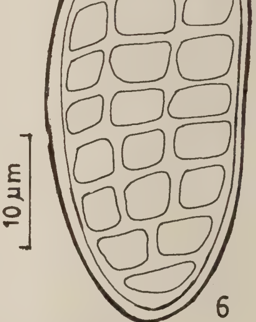

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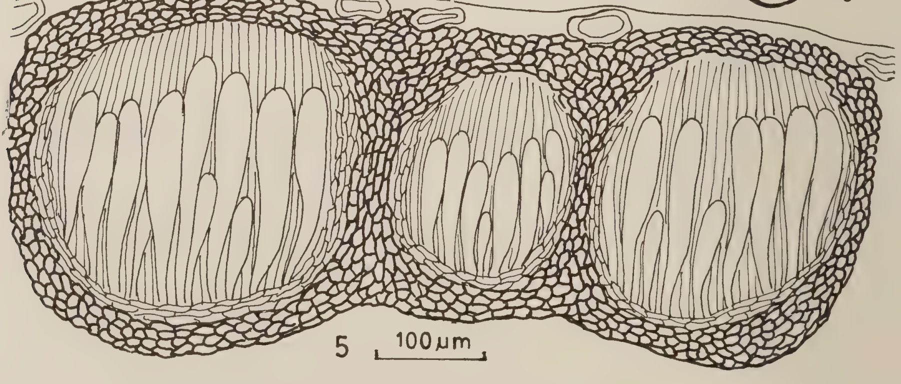

5

Julella multiloculata sp.nov. (Figs. 5,6)

Stromata innate, exposed through bark, elongated, black multilocular, 600-900 x 300-400 µm. Locules many, embedded in stroma, arranged in a row, globose; each locule measuring 200-320 x 200-360 µm; wall composed of flattened cells on inner side and irregular to globose cells on outer side. Asci many, in basal layers, bitunicate, cylindrical to club shaped, stalked to subsessile, octosporous, paraphysoids present, asci 120-180 x 17-25 µm. Ascospores 8, muriform, golden yellow to light brown 30-45 x 14-16 µm.

Growing on twigs of *Punica granatum* L. at Pune (Maharashtra) dt. 3.X.1981. AMH 7150 (Holotype).

Stromata immersa in corticem, multiloculata, nigra, erumpentia per cortice, exposita pro elongata rima, 600-900 x 300-400 µm, loculi pluri, innati in stroma, lineati dispositi, globosi, paries compositae ex cellulae hyalineae, compressae; loculi magnit. 200-320 x 200-360 µm. Asci numerosi in basalis strato, bitunicati, cylindrici vel clavati, stipitati vel subsessili, octospori, paraphysoidibus, 120-180 x 17-25 µm. Ascosporae 8, muriformae, aureae vel pallide brunneae, 30-45 x 14-16 µm.

Ad caulibus mortuis *Punica granatum* L. dt. 3.X.1981. Pune (Maharashtra). AMH 7150 (Holotypus).

This fungus is closest to *Julella* (Barr, Personal communication, Barr 1985). However, presence of multiloculate stromatic fruit bodies and 8 lightly pigmented ascospores per mature ascus distinguish it from other species of *Julella* which normally have uniloculate ascomata and usually less than 8 hyaline ascospores per ascus at maturity. The species is named to indicate its multiloculate nature.

ACKNOWLEDGEMENTS

Grateful thanks are offered to Dr.P.G.Patwardhan, The Director M.A.C.S. Research Institute, Pune for facilities.

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Didymella capparidis sp.nov. (Figs.1-4) 1. stroma (diagramatic), 2. locule, 3. ascus, 4. ascospores. *Julella multiloculata* sp.nov. (Figs. 5,6) 5. stroma, 6. ascospores.

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THE GENUS CHAETOMASTIA (DACAMPIACEAE) IN NORTH AMERICA

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ABSTRACT

Chaetomastia is reinstated as an older name for some species recently assigned to *Massariosphaeria*. Seven North American species are described and illustrated, including the type species *C. hirtula*. New combinations are proposed for *C. clavispora*, *C. phaeospora*, *C. sambuci*, *C. sambucina*, *C. typhicola*, and the new species *C. equiseti* is described.

The name *Chaetomastia*, first proposed by Saccardo (1883) as subgenus III of *Melanomma* "Perithecia setulosa", has scarcely been used since Berlese (1891) raised it to generic rank. Two species are listed in the checklist to British Ascomycotina (Cannon et al. 1985) and the genus is included in "Unitunicate Ascomycetes, inc. sed." by O. Eriksson and Hawksworth (1987). Saccardo listed *Melanomma hirtulum* (Karsten) Sacc., *M. pilosellum* Karsten, *M. canescens* Speg., *M. hispidulum* Sacc. and *M. ? cucurbitarioides* Speg. within the subgenus. Berlese (1891) transferred these taxa to *Chaetomastia*, but was unable to study *C. cucurbitarioides*. He added *C. juniperina* (Karsten) Berlese and *C. aculeata* (Mouton) Berlese. He excluded *M. (C.) plejosporum* Mouton with muriform ascospores and suggested that it belonged in *Capronia*. *Chaetomastia pilosella* is *Herpotrichiella pilosella* (Karsten) Munk (Munk 1957); *C. hispidula* and *C. aculeata* probably belong in *Herpotrichiella* also. The disposition of other species except for *C. hirtula* is uncertain to me at present.

Clements and Shear (1931) designated *C. hirtula* [ut (Karsten) Sacc.] as lectotype species of the genus and submerged it under *Lasiosphaeris* Clements (=*Lasiosphaeria*). The typification was accepted in ING (Farr et al. 1979) and *Chaetomastia* is thus based upon *C. hirtula*. This species was described in some detail as *Melanomma hirtulum* by Holm (1957), who recognized that disposition out of *Melanomma* would be necessary. Leuchtmann (1985) transferred the species to the expanded *Montagnula*, which includes phragmosporous species (Crivelli 1983), because of the dark reddish brown, asymmetric, thick-walled, verruculose ascospores and the presence of abundant hyphae around ascomata. *Montagnula*, according to the type species *M. infernalis* (Niessl) Berlese has abundant hyphae, sometimes massed as stromatic tissues or forming a clypeus over the sphaeroid, thin-walled ascomata, and dark reddish brown, symmetric, thick-walled, verruculose dictyospores. It appears to belong in the Phaeosphaeriaceae (Barr 1987). *Chaetomastia* on the other hand has the characteristics of the Dacampiaceae (Barr 1987), i.e., obpyriform or obovoid ascomata with a wide apical papilla, peridium of small dark cells that is widest and three layered in the upper regions. These characteristics and the dark asymmetric phragmospores are identical with those of the type species of *Massariosphaeria*, *M. phaeospora* (Müller) Crivelli. Thus, it is necessary to utilize the earlier name *Chaetomastia* to include phragmosporous species placed in *Massariosphaeria* by Crivelli (1983) and Leuchtmann (1985), in addition to *C. hirtula*. The enlarged concept of *Massariosphaeria* set forth by Crivelli (1983) that includes dictyosporous species is not accepted here, not so much on account of ascospore septation but because the species, notably *M. rubicunda* and allies, differ in ascoma and locule structure to the extent that they are to be removed to *Karstenula* (Melanommatales, Didymosphaeriaceae). At least some of the species that Leuchtmann (1985) added to *Massariosphaeria* are closely related to the type of that genus. He noted that one group of species developed in arctic-alpine regions on dicot substrates and a second at lower altitudes, mostly littoral, on monocots. The North American taxa included here have a similar diversity of substrate and distribution.

Chaetomastia (Sacc.) Berlese, Icon. Pyren. 1: 38. 1891.

Melanomma subg. III. *Chaetomastia* Sacc.Syll. Fung. 2: 113. 1883.

Massariosphaeria (Müller) Crivelli, Dissert. ETH Nr. 7318: 141. 1983.

Leptosphaeria subg. *Massariosphaeria* Müller, Sydowia 4: 206. 1950.

Ascomata immersed becoming erumpent and appearing superficial when epidermis sloughed, separate or gregarious, obpyriform or ovoid to globose, at times somewhat elongate ellipsoid, medium sized; apex wide and blunt, ostiole rounded or slitlike; peridium composed of brown, pseudoparenchymatous cells externally, darkened and thickened in upper regions, internally of pallid compressed rows of cells, with sparse or numerous brown hyphae into substrate. Asci bitunicate, basal to peripheral, clavate or cylindric, 4-, 6-, or 8-spored. Pseudoparaphyses cellular, in gel matrix, extending into ostiole. Ascospores yellowish brown becoming dark brown or reddish brown, obovoid elongate, slightly or strongly asymmetric with obtuse upper hemispore usually shorter and wider than more tapered and more acute lower hemispore, usually inequilateral to slightly curved, three to eleven septate, constricted at first formed septum, cell above this usually enlarged; wall wide, dark, smooth or verruculose, surrounded by gel coating; contents with large globule in each cell; biseriate or uniseriate in the ascus.

Anamorphs coelomycetous where known; conidia hyaline or brown, one celled or one septate, (*Aposphaeria*- or *Coniothyrium*-like).

Saprobic, perhaps hemibiotrophic, in woody or herbaceous stalks and branches, alpine, or in monocot culms, low altitudes.

Lectotype species: *C. hirtula* (Karst.) Berlese (Clements and Shear 1931, Farr et al. 1979).

Key to North American Species

1. Ascospores 3-septate, usually less than eight per ascus; arctic alpine..2

1. Ascospores 4-11-septate, usually eight per ascus........3

  2. Ascospores 17-25.5 x 6.5-9.5 µm, four per ascus...*C. hirtula*

  2. Ascospores 14-25 x 6-7.5 µm, six (rarely eight) per ascus...................................*C. sambuci*

3. Ascospores (20-)22-32 x 6-7.5 µm, 4-6-(7-8-)septate; alpine...*C. sambucina*

3. Ascospores wider, 7-13 µm, 5-7-9-11-septate............4

  4. Ascospores (3-4-)5-septate, 30-38 x 10-13 µm; lower altitudes....................................*C. equiseti*

  4. Ascospores (3-)7-11-septate, relatively narrower...5

5. Ascomata elongate to 1 mm; ascospores 31-39 x 7.5-10 µm, 9-11-septate, conspicuously asymmetric with long tapered lower hemispore; lower altitudes..............*C. clavispora*

5. Ascomata rounded; ascospores not so conspicuously asymetric...6

  6. Ascospores 25-39 x 7-10.5 µm; lower altitudes...*C. typhicola*

  6. Ascospores 26-36 x 9-12 µm; arctic alpine...*C. phaeospora*

Chaetomastia clavispora (Cooke & Peck) Barr, **comb. nov.** Figs. 12, 13

Hysterium clavisporum Cooke & Peck, New York State Museum Rep. 28: 69. 1876; Bull. Buffalo Soc. 3: 34. 1875.

Dothidea clavispora (Cooke & Peck) Peck, New York State Museum Rep. 29: 63. 1878.

Rhopographus clavisporus (Cooke & Peck) Sacc. Syll. Fung. 2: 648. 1883.

Calospora clavispora (Cooke & Peck) Theissen & H.Sydow, Ann. Mycol. 13: 428. 1915.

Phaeosphaeria clavispora (Cooke & Peck) Barr in Barr et al., New York State Museum Bull. 459: 15. 1986.

Leptosphaeria clavicarpa Ellis & Everh. J. Mycol. 1: 43. 1885.

Heptameria clavicarpa (Ellis & Everh.) Cooke, Grevillea 18: 32. 1889.

Ascomata immersed, elongate, 500-1000 µm or more, 200-300 µm wide, apex obtuse, opening by wide rounded or somewhat slitlike pore; peridium 26-40 µm wide. Asci 88-105 x 22-25 µm. Ascospores 31-39 x 7.5-10 µm, yellowish brown to dark brown, obovoid, asymmetric, long taper to base, usually slightly curved, 9-11-septate, septation 2-1-6 or

3-1-7, constricted at first formed septum; wall smooth, surrounded by gel coating.

In dead culms of *Phragmites communis* Trin., eastern and midwestern North America.

Material examined: NEW YORK: Tyre, Seneca Co., Sep 1871, C. H. Peck (NYS, two collections, isotype); Watkins, Schuyler Co., Sep, Peck, Montezuma, Seneca Co., Sep, Peck; Bergen swamp, Genessee Co., 14 Aug 1916, H. D. House; Bonaparte swamp, Lewis Co., 23 Jun 1920, House; Newcomb, Essex Co., 2 Jul 1925, House (all NYS). NEBRASKA: Callaway, Custer Co., Apr 1902, J. M. Bates, Fungi Col. 1674 (MASS, NYS).

The formation of elongate ascomata with a single locule or sometimes several locules in a row, is one feature of the species. Another is the conspicuous asymmetry of the ascospores, the upper hemispore short and wide with two or three septa, the lower narrower with a long taper and six or seven septa.

Chaetomastia equiseti Barr, **sp. nov.** Figs. 8, 9

Ascomata immersa discreta vel gregaria 330-440 µm diametro ovoidea, apices lati, peridium 25-35 µm tomentosum. Asci bitunicati clavati 100-175 x 18-22 µm. Ascosporae 30-38 x 10-13 µm spadicea sed pallidae ad apicem fusoideae obovoideae 3-4-5-septatae, parietes verruculosi.

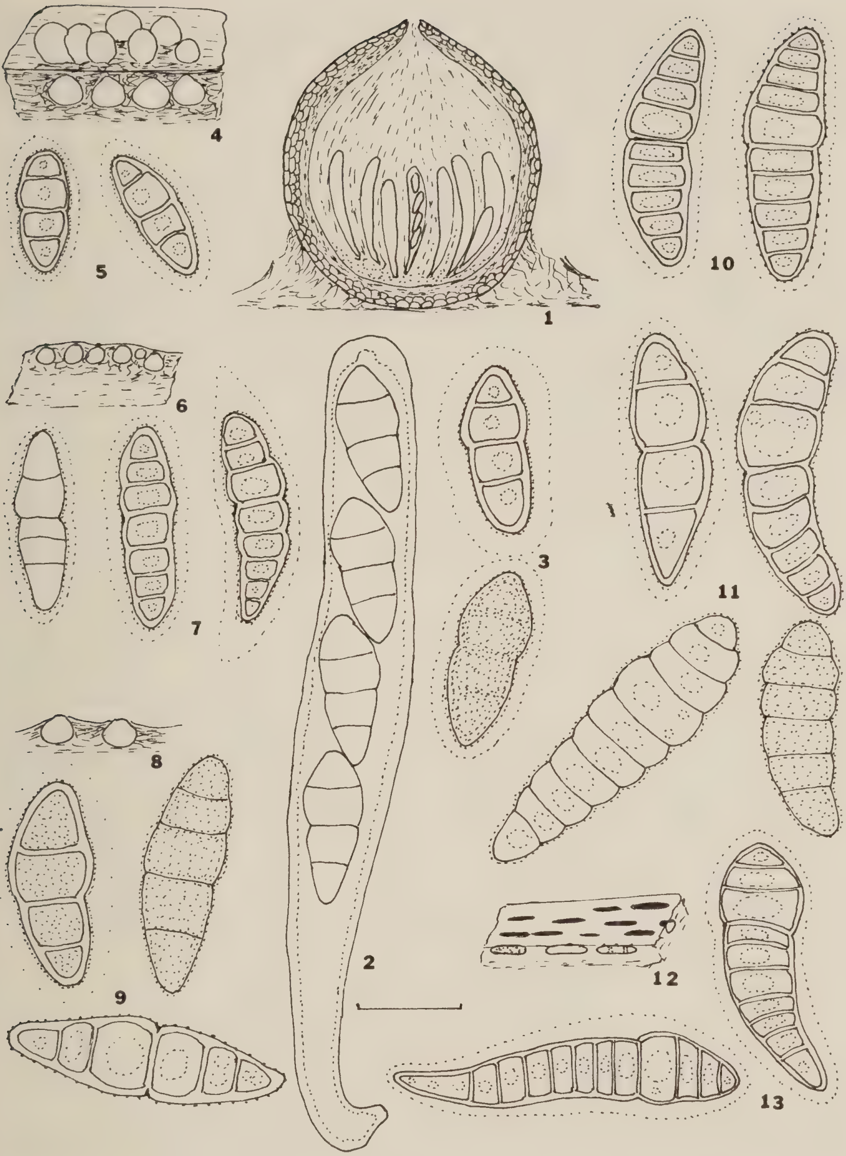
In caulibus emortuis *Equiseti hyemale* L., "Spring Farm, Carrabassett, Franklin Co., Maine, 30 Aug 1971," a M. E. Barr 5857 lecti (MASS, holotypus).

Ascomata immersed, separate or gregarious, 330-440 µm diam, ovoid, apex wide; peridium 25-35 µm wide, tomentose with brown hyphae. Asci 100-175 x 18-22 µm. Ascospores 30-38 x 10-13 µm, bright brown, ends pallid, fusoid obovoid, only slightly asymmetric, 3-4-5-septate, constricted at first formed septa, cell above slightly wider; wall verruculose, surrounded by gel coating.

On old stalks of *Equisetum hiemalis*, known only from type collection.

This species evidently has not been found previously, for none of the taxa described in the literature is similar to it. The broad apices of ascomata make it more conspicuous than *Phaeosphaeria berlesei* (Larsen & Munk) Hedjaroude which occurs in the same collection.

Figs. 1-13. Species of *Chaetomastia*. 1-3. *C. hirtula*: 1. ascoma in vertical section; 2. ascus; 3. ascospores. 4,5. *C. sambuci*: 4. habit of ascomata; 5. ascospores. 6,7. *C. sambucina*: 6. habit of ascomata; 7. ascospores. 8, 9. *C. equiseti*: 8. habit of ascomata; 9. ascospores. 10. *C. phaeospora*, ascospores. 11. *C. typhicola*, ascospores. 12,13. *C. clavispora*: 12. habit of ascomata; 13. ascospores. Standard line = 150 µm for fig. 1, 15 µm for ascus and ascospores. Habit sketches not to scale.



Chaetomastia hirtula (Karsten) Berlese, Icon. Fung. 1: 39. 1891. Figs. 1-3

Sphaeria hirtula Karsten, Fungi Fenn. exs. n. 825. 1869.

Melanomma hirtulum (Karsten) Sacc. Syll. Fung. 2: 113. 1883.

Montagnula hirtula (Karsten) Leuchtmann, Sydowia 37: 178. (1984) 1985.

Melanomma glaciale Rehm, Osterr. Bot. Z. 56: 294. 1906.

Melanomma suldensis Rehm, Ann. Mycol. 5: 539. 1907.

Ascomata gregarious, immersed or appearing superficial when epidermis sloughed, ovoid, 300-440 µm diam, up to 450 µm high; peridium 40-45 µm wide. Asci 88-120 x 11-15 µm, 4-spored. Ascospores 17-25.5 x 6.5-9.5 µm, dark brown, obovoid, asymmetric, 3-septate, constricted at first formed septum; wall verruculose, surrounded by gel coating.

On woody canes of *Rubus* spp., herbaceous stalks of *Cerastium*, *Veratrum*, arctic alpine Europe, North America.

Material examined: SWEDEN: Uppland, Dalby par., Jerusalem, 2 May 1980, K. & L. Holm (UPS). FINLAND: Mustiala, May 1866, Karsten, Fungi Fenn. exs. 825 (FH, isotype). CANADA: BRITISH COLUMBIA: ridge north of Mimulus Lake, Garibaldi Prov. Park, 2 Aug 1952, M. E. Barr 607 (MASS).

The tetrasporous asci and three-septate, dark ascospores are characteristic for this species. Holm (1957) found ascospores in the range of 22-30 x 7.5-10 µm in European material from *Rubus* and *Cerastium*. Leuchtmann remarked on some variation between collections from *Rubus* and *Epilobium*, with larger ascospores, and from *Cerastium* with smaller ascospores (11-20 x 7.5-10 µm). The North American specimen on *Veratrum viride* Ait. has ascospores that are intermediate in lengths between the European materials.

Chaetomastia phaeospora (Müller) Barr, **comb. nov.** Fig. 10

Leptosphaeria phaeospora Müller, Sydowia 4: 208. 1950.

Trematosphaeria phaeospora (Müller) Holm, Symb. Bot. Upsal. 14(3): 165. 1957.

Massariosphaeria phaeospora (Müller) Crivelli, Dissert. ETH 7318: 141. 1983.

Ascomata immersed, ca. 440 µm diam, 500-550 µm high, obpyriform; peridium ca. 15 µm wide below, light brown, dark brown and up to 30 µm in upper regions, surrounded by scanty brown hyphae. Asci 150-180 x 20-23 µm, octosporous. Ascospores 26-36 x 9-12 µm, dark brown, obovoid, asymmetric, usually slightly curved, 7-9-(11-)septate; wall thick, smooth or verruculose, surrounded by gel coating.

In stalks of *Artemisia*, *Trisetum*, alpine Europe; *Phlox douglasii* Hook., alpine western North America.

Material examined: SWITZERLAND: Kt. Wallis, Findelen, 10 Sep 1895, H. Wegelin (ZT, holotype). CANADA: BRITISH COLUMBIA: Ridge north of Mimulus Lake, Garibaldi Prov. Park, 2 Aug 1952, M. E. Barr 614 (MASS).

The North American collection matches the holotype material quite precisely; the only difference seen is that ascospores in the holotype are smooth walled beneath the gel coating whereas those of Barr 614 are verruculose. Müller (1950) found ascospores up to 41 µm long. Leuchtmann (1985) obtained *Aposphaeria*-like conidiomata in culture from a collection on *Trisetum*.

Chaetomastia sambuci (Earle) Barr, **comb. nov.** Figs. 4, 5
Melanomma sambuci Earle, Bull. New York Bot. Garden 3: 291. 1904.

Ascomata gregarious, sides connected at times, immersed becoming widely erumpent, globose, 385-550 µm diam or forming small stromata up to 1 mm diam containing three or four locules, apex rounded with minute papilla, surface irregular or rugose; peridium (13-)25-50 µm wide, with brown hyphae at base into substrate. Asci 85-100(-130) x 10-13 µm, mostly 6-spored. Ascospores (14-)18-25 x 6-7.5 µm, reddish brown, 3-septate, constricted at first formed septum, cell above enlarged slightly; wall verruculose, surrounded by gel coating.

Associated conidiomata similar in structure and sizes to ascomata; conidia 5-9 x 4-7.5 µm, brown, globose to ellipsoid, one celled or one septate. (*Coniothyrium sambuci* Earle was described from Nevada as Baker 1181 part).

On dead branches of *Sambucus* spp., alpine western North America.

Material examined: MONTANA: Sperry Trail, Glacier Nat'l Park, 27 Jul 1961, W. B. & V. G. Cooke 32665 (MASS). NEVADA: Snow Valley Peak, Ormsby Co., 14 Jun 1902, C. F. Baker 1182 part (NY, holotype).

In both collections cited, the ascomata are widely erumpent over immersed, empty ascomata and hyphae that had matured beneath the periderm. No features remain to show whether these ascomata were of the same or another taxon. *Chaetomastia sambucina* has more elongate and asymmetric ascospores that develop additional septa. It is possible that these are simply variations within one species.

Chaetomastia sambucina (Ellis & Everh.) Barr, **comb. nov.** Figs. 6, 7
Leptosphaeria sambucina Ellis & Everh. Proc. Acad. Nat. Sci. Philadelphia 46: 336. 1894.

Ascomata gregarious, occasionally sides connected, immersed, 495-550 µm diam, 500-825 µm high; peridium ca. 30 µm wide, blackened above and up to 60 µm wide, ample brown hyphae into substrate. Asci 80-120 x 12-15 µm, octosporous. Ascospores 22-32 x 6-7 µm, dark brown or reddish brown, narrowly obovoid, 4-6(7-8-)septate; wall verruculose, surrounded by gel coating.

In branches of *Sambucus melanocarpa* Gray, alpine western North America.

Material examined: COLORADO: Cameron Pass, Jackson Co., 24 Jul 1894, C. F. Baker (MASS, isotype).

Conidiomata are intermixed with and similar in appearance to ascomata; conidia are brown, globose, one celled, 7-9 µm.

Chaetomastia typhicola (Karsten) Barr, **comb. nov.** Fig. 11

Leptosphaeria typhicola Karsten, Mycol. Fenn. 2: 100. 1873.

Phaeosphaeria typhicola (Karsten) Hedjaroude, Sydowia 22: 86. 1968.

Massariosphaeria typhicola (Karsten) Leuchtmann, Sydowia 37: 168. (1984) 1985.

Leptosphaeria occidentalis Ellis & Everh. Erythea 2: 20. 1894.

Leptosphaeria baldingerae Fautrey & Lambotte, Rev. Mycol. (Toulouse) 19: 3. 1897.

Phaeosphaeria baldingerae (Fautrey & Lambotte) Hedjaroude, Sydowia 22: 87. 1968.

Ascomata immersed, separate or gregarious, ovoid or globose, at times ellipsoid, 245-430 µm diam; peridium 15-25 µm wide, surrounded by tomentum of interwoven hyphae. Asci (67-)90-135 x 15-18 µm. Ascospores 25-39 x 7-10.5 µm, yellowish brown becoming dark brown, asymmetric, slightly curved, 3-7-9-septate; wall verruculose, surrounded by gel coating.

In old culms of monocots, low altitudes, Europe, North America (*Echinochloa crusgalli* (L.) Beauv., *Panicum virgatum* L., *Zea mays* L. in North America.)

Material examined: MASSACHUSETTS: North Amherst, Hampshire Co., 29 Apr 1959, M. E. Barr 2549 (MASS). KANSAS: Rockport, Rooks Co., Apr 1893, E. Bartholomew, Ellis & Everh. NAF 2925 (DAOM, MASS, isotype *L. occidentalis*); Stockton, Rooks Co.,22 May 1906, E. Bartholomew Fungi Col. 2629 (MASS).

The concept of this species as a polyphagous one follows that of Leuchtmann (1985) who also described the formation of *Aposphaeria*-like conidiomata or ascomata of the teleomorph from different isolates. Lucas and Webster (1967) also obtained the anamorph in culture. The isotype material of *L. occidentalis* is not separable from *C. typhicola*. The North American specimens that I studied do not show the full range in variability of ascospores noted by Leuchtmann which caused him to combine *L. typhicola* and *L. baldingerae* as one species. Kohlmeyer and Kohlmeyer (1979) provided a description of *L. typhicola* in which ascospore sizes are 34-52(-62) x 7-10(-13) µm. They reported the species from decaying culms of *Juncus* and *Spartina* in marine sites in North Carolina and Argentina.

I acknowledge with gratitude the curators of herbaria (FH, NY, NYS, UPS, ZT) whose loans of specimens made this study possible, and thank Dr. J. Boise for reviewing the manuscript.

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THE GENUS DOTHIDOTTHIA (BOTRYOSPHAERIACEAE) IN NORTH AMERICA

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ABSTRACT

Dothidotthia is accepted for a group of *Botryosphaeria*-like species whose ascospores are mostly one septate and brown. The type species is redescribed as *D. aspera*, *D. ramulicola* is accepted, and other North American species: *D. celtidis*, *D. fruticola*, *D. lasioderma*, *D. quercicola*, are proposed in new combinations. *Dothidotthia diapensiae* is described as new.

The genus *Dothidotthia* is recognized as a member of the Botryosphaeriaceae (Barr 1987). As in species of *Botryosphaeria*, the erumpent ascomata, whether separate or grouped, have a peridium composed of large, brown, pseudoparenchymatous cells and produce more or less abundant coarse, brown hyphae. The asci are oblong clavate, with thick endotunica, and are basal among relatively wide, cellular pseudoparaphyses. The ascospores separate species of *Dothidotthia* from species of *Botryosphaeria*: they are shades of brown and one to three septate. Associated coelomycetous anamorphic states are known for a few species and are *Diplodia*-like.

Dothidotthia was described for *Pseudotthia symphoricarpi* Rehm, as a member of Eu-Montagnelleae in the Montagnellaceae of the Dothideales (von Höhnel, 1918, 1919). Petrak (1924) recognized that it was separate from *Otthia* (a genus of the Cucurbitariaceae) and compared *Dothidotthia* with *Antennularia* and *Pseudotthia*. Later (Petrak, 1927) he decided that it was not separable from *Dibotryon*. Von Arx (1954) removed *D. symphoricarpi* to *Gibbera*, and Müller and von Arx (1962) included both *Dothidotthia* and *Pseudotthia* as synonyms of *Gibbera*. Shoemaker (1963) concurred, as do O. Eriksson and Hawksworth (1987). But *Gibbera*, as well as *Antennularia (= Protoventuria)* and *Dibotryon*, belong in the Venturiaceae. Their ascomata have a peridium of small pseudoparenchymatous cells, hyphae are narrow, asci are oblong or cylindric and have a thin endotunica, pseudoparaphyses are narrow and often deliquescent, and known anamorphic states are hyphomycetous. *Otthia* also differs from *Dothidotthia* in having a three-layered, smaller-celled peridium, although the anamorphic state of *O. spiraeae* (Fuckel) Fuckel does not seem to be generically different from that of *Botryosphaeria obtusa* (Schwein.) Shoemaker or

Dothidotthia ramulicola.

The examination of numerous collections described or disposed under a variety of generic names (chiefly *Otthia*, *Didymosphaeria*, *Parodiella*, but also *Amphisphaeria*), permits compilation of the species of *Dothidotthia* in North America. Two series of species are evident in the genus, one with light clear brown or light reddish brown ascospores, one or three septate, the other with dark reddish brown ascospores, mostly one septate.

Dothidotthia von Höhnel, Ber. Deutsch. Bot. Ges. 36: 312. 1918.

Ascomata immersed becoming erumpent, finally appearing superficial, usually gregarious, often in rows or in small rounded groups, at times connected at sides, globose, sphaeroid or ovoid, medium sized, rarely small; apex rounded, with short or well developed papilla, often opening widely by rounded ostiole, stuffed with hyaline cells; surface smooth or roughened with protruding cells or bearing short to elongate hyphal appendages; peridium wide, composed externally of rows of large, brown-walled, pseudoparenchymatous cells, often blackened over surface, internally of more compressed rows of pallid cells, at times wedge-shaped groups of cells extending from lower sides, or basal portion of peridium thickened and hypostromatic; hyphae dark brown, coarse, forming slight or well-developed subiculum beneath and connecting ascomata. Asci bitunicate, basal, clavate or oblong, endotunica thickened. Pseudoparaphyses cellular, usually wide. Ascospores yellowish to clear or dull brown or dark reddish brown, ellipsoid, fusoid, obovoid, ends obtuse or somewhat acute, straight, inequilateral or slightly curved, one to three septate, infrequently one celled or two or more septate, not or slightly constricted at septum; contents minutely granular, finally one globule per cell; wall thick, smooth or verruculose at times, occasionally surrounded by narrow gel coating; overlapping biseriate in the ascus.

Anamorphic states: coelomycetous where known; conidiomata similar in aspect and structure to ascomata; conidiogenesis holoblastic; conidia brown, one celled or septate.

Type species: *D. symphoricarpi* (Rehm) von Höhnel = *Plowrightia symphoricarpi* Ellis & Everh. = *D. aspera* (Ellis & Everh.) Barr

Key to North American Species

1. Ascospores light brown (clear brown, yellowish brown, reddish brown), often inequilateral or slightly curved, 1-3-septate..2

1. Ascospores dark reddish brown, usually straight, (0-)1-(2-)septate..6

2. Ascomata much depressed; ascospores 14.5-20 x 5.5-6.5 µm, 1-septate, in short wide asci....*D. diapensiae*

2. Ascomata not strongly depressed; ascospores larger, in oblong clavate asci..................................3

3. Ascomata clothed with hyphal appendages; ascospores 3-septate, 24-33(-38) x (6-)7.5-11 µm...........*D. lasioderma*

3. Ascomata not clothed with hyphal appendages, slightly rough; ascospores 1-(3-)septate............................4

4. Ascomata causing hypertrophy in twigs of *Quercus*; ascospores 20-24 x 9-10(-11) µm, obovoid..*D. quercicola*

4. Ascomata not causing noticeable hypertrophy; ascospores ranging larger................................5

5. Ascomata globose sphaeroid (diam same or greater than height); ascospores (17.5-)20-30(-32) x (6.5-)7.5-11(-12.5) µm.......................................*D. aspera*

5. Ascomata globose to ovoid (diam mostly less than height); ascospores 26-39 x 10-12(-15.5) µm.............*D. fruticola*

6. Ascomata much depressed; ascospores 19-27 x 9-13 µm in short wide asci.........................*D. celtidis*

6. Ascomata not strongly depressed; ascospores (15-)18-25(-34) x (8-)10-13(-16) µm in oblong-clavate asci..*D. ramulicola*

Dothidotthia aspera (Ellis & Everh.) Barr, **comb. nov.** Figs. 1-3

Amphisphaeria aspera Ellis & Everh. Bull. Torrey Bot. Club 27: 52. 1900.

Plowrightia symphoricarpi Ellis & Everh. Proc. Acad. Nat. Sci. Philadelphia 42: 249. 1890.

Otthia symphoricarpi (Ellis & Everh.) Ellis & Everh. North Amer. Pyrenomyc. 249. 1892.

Valsaria symphoricarpi (Ellis & Everh.) Theissen & H. Sydow, Ann. Mycol. 13: 327. 1915.

Pseudotthia symphoricarpi Rehm, Ann. Mycol. 11: 169. 1913.

Dothidotthia symphoricarpi (Rehm) von Höhnel, Ber. Deutsch. Bot. Ges. 36: 312. 1918.

Dibotryon symphoricarpi (Rehm) Petrak, Ann. Mycol. 25: 301. 1927.

Gibbera symphoricarpi (Rehm) von Arx, Acta Bot. Neerl. 3: 85. 1954.

Gibbera andersonii Shoemaker, Canad. J. Botany 41: 1421. 1963.

Otthia fendleraecola Earle in Greene, Pl. Bakerianae 1: 14. 1901.

Otthia distegiae Tracy & Earle in Greene, Pl. Bakerianae 1: 29. 1901.

Ascomata erumpent, gregarious in groups or rows, occasionally separate, (180-)300-660 µm diam, (180-)320-495 µm high; apex rounded, short papillate, often slightly depressed around papilla; surface dull black, slightly roughened; peridium (20-)40-60(-80) µm wide, of brown cells up to 13 µm diam, with coarse brown hyphae into substrate. Asci (65-)80-120(-140) x (10-)16.5-23 µm. Ascospores (17.5-) 20-30(-32) x (6.5-)7.5-11(-12.5) µm, light clear brown, ellipsoid, ends tapered, obtuse or somewhat acute, often inequilateral, 1-(3-)septate, slightly constricted; wall smooth.

In woody branches (*Fendlera*, *Lonicera*, *Populus*, *Symphoricarpos*, *Tetradymia*), mid and western North America.

Material examined: BRITISH COLUMBIA: Soda Creek, 3 Jun 1951, J. Bancroft (UBC 2336). NORTH DAKOTA: Kulm, J. D. Brenckle, Rehm Ascom. 2040 (BPI, NY, isotype *Pseudotthia* *symphoricarpi*); 7 Mar 1909, N.D. Fungi 260, Fungi Dakotenses 98 (BPI, NY, as *Otthia symphoricarpi*); 10 May 1914, Sydow F. exot. exs. 391 (BPI, NY, as *Pseudotthia symphoricarpi*). MONTANA: Sand Coulee, 24 Dec 1888, F. W. Anderson 110 (NY, holotype *Plowrightia symphoricarpi*); Helena, 1 Apr 1889, F. D. Kelsey (NY); Great Falls, F. W. Anderson, NAF 2374 (MASS, NY). COLORADO: Montrose, E. Bethel 517 (NY, holotype *Amphisphaeria aspera*); Hermosa, 4 Apr 1899, C. F. Baker 75 and Pl. Southern Colorado 432 (NY, holotype *Otthia fendleraecola*); Berkeley Bluffs, 12 May 1906, F. J. Seaver & E. Bethel (NY as *Otthia symphoricarpi*); Mancos, 25 Jun 1898, Pl. Southern Colorado 1090 (NY, holotype *Otthia distegiae*, two packets); Durango, 20 Mar 1899, C. F. Baker 10 and Pl. Southern Colorado 43 (NY); Durango, 2 Jul 1907, F. E. & E. S. Clements, Crypt. Form. Colorad. 43 (NY). OREGON: 48 km N Madras, Wasco Co., 18 Aug 1977, A. Y. Rossman (MASS).

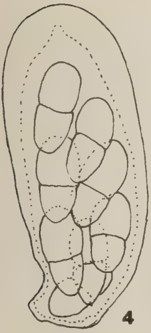
Some variability in aspect, shapes and sizes is evident among these collections, but the overlap among them makes it impossible to separate more than one species. Although the specific epithet of *Plowrightia symphoricarpi* is the earliest, combination in *Dothidotthia is precluded by D. symphoricarpi* (Rehm) von Höhnel. Shoemaker (1963) provided *Gibbera andersonii* as replacement. He discussed and clarified confusion with this species and *Griphosphaerioma kansensis* (Rehm) Shoemaker, which is also present on several of the collections. *Amphisphaeria aspera* provides the earliest available name now. The ascospores are typically one septate and ascomata lack the vestiture found in *D. lasioderma*.

The type specimen of *A. aspera* bears conidiomata intermixed with ascomata and similar in appearance. Conidia are (10-)12-15 x 6-7 µm, dark brown, (1-)3-septate with occasionally a longitudinal septum in one cell.

Dothidotthia celtidis (Ellis & Everh.) Barr, **comb. nov.**
Figs. 12, 13
Didymosphaeria celtidis Ellis & Everh. Proc. Acad. Nat. Sci. Philadelphia 47: 421. 1895.
Microthelia celtidis (Ellis & Everh.) O. Kuntze, Rev. Gen. Pl. 3: 498. 1898.

Ascomata immersed, apices only emergent, scattered to gregarious beneath and raising periderm, sphaeroid, 220-440 µm diam, 130-275 µm high, apex blunt; peridium 25-30 µm, of large brown pseudoparenchymatous cells. Asci 60-70 x 25-28 µm. Ascospores 19-27 x 9-12.5 µm, dark brown, broadly ellipsoid, (0-) 1-septate, not constricted; wall thick, smooth, at times surrounded by gel coating.

Figs. 1-15. Species of *Dothidotthia*. 1-3. *D. aspera*: 1. ascoma in vertical section. 2. ascus. 3. ascospores. 4, 5. *D. diapensiae*: 4. ascus. 5. ascospores. 6, 7. *D. fruticola*: 6. habit of ascomata. 7. ascospores. 8, 9. *D. lasioderma*: 8. habit of ascoma. 9. ascospores. 10, 11. *D. quercicola*: 10. habit of ascomata. 11. ascospores. 12, 13. *D. celtidis*: 12. ascoma in vertical section. 13. ascospores. 14, 15. *D. ramulicola*: 14. habit of ascomata. 15. ascospores. Standard line = 150 µm for ascomata; 15 µm for asci and ascospores.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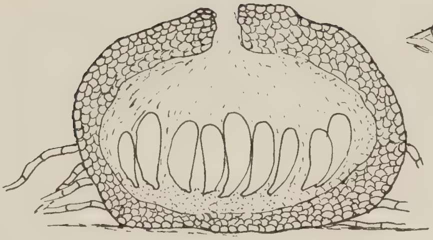
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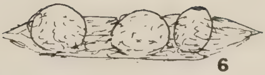
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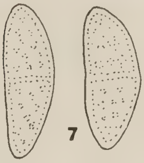
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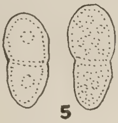
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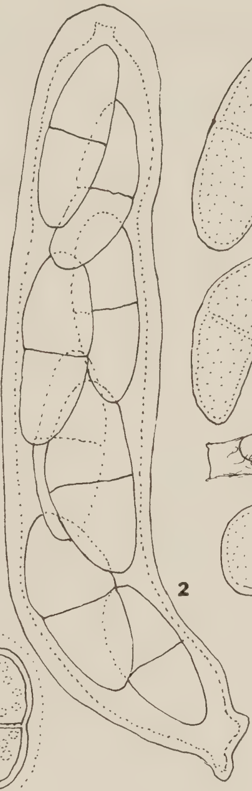
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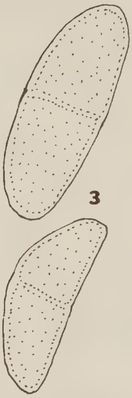
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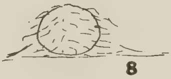
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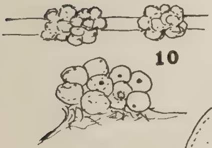
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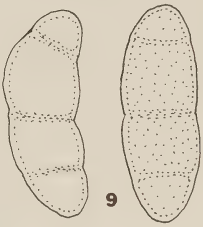
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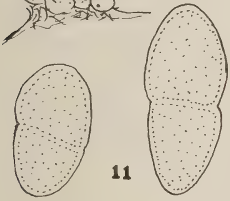
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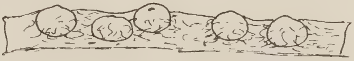
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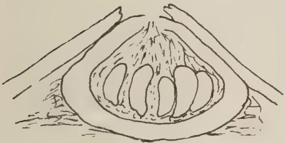
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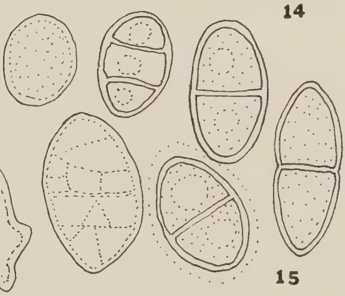
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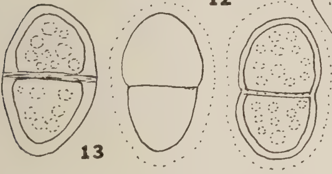
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In branches of *Celtis occidentalis* L., eastern and midwestern North America.

Material examined: NEW YORK: Orient, Long Island, 14 Feb 1923, R. Latham (NY). KANSAS: Rooks Co., 23 May 1894, E. Bartholomew 1467 (NY, holotype, 2 packets). OKLAHOMA: Ripley Bluff, N. of Ripley, Payne Co., 11 Aug 1979, M. E. Barr 6586 (MASS).

The protologue gives May 1895, but the collection marked as type is dated 23 May 1894. This taxon is retained separately from *D. ramulicola* on the bases of much depressed ascomata and shorter asci. The ascospores are quite similar in both taxa. An anamorphic state is present on some of the twigs; *Sphaeropsis celtidis* Ellis & Everh. (Amer. Nat. 428. 1897) was described for such a species, having brown, one-celled conidia 18-21 x 8-10 μm.

Dothidotthia diapensiae Barr, **sp. nov.** Figs. 4, 5

Ascomata immersa subcuticularia sphaeroidea 105-135 μm diametro 75-90 μm alto, peridia ad 25 μm lata. Asci bitunicati oblongi 36-57 x 15-18 μm. Ascosporae 14.5-20 x 5.5-6.5 μm flavidae brunneae obovoideae uniseptatae.

In foliis *Diapensiae lapponicae*, "Northwest Territories, Baffin Island, head of Clyde Inlet, 6 Jul 1950," a P. Dansereau 5007062299a lecti (MASS, holotypus).

Ascomata immersed, subcuticular, visible through thickened cuticle, much depressed to almost lens shaped in section, 105-135 μm diam, 75-90 μm high, apex minutely papillate; peridium ca. 25 μm wide at sides, 10 μm toward apex and base, composed of large, brown, pseudoparenchymatous cells, brown hyphae penetrating substrate between epidermal cells. Asci 36-57 x 25-28 μm. Ascospores 14.5-20 x 5.5-6.5 μm, yellowish to light dull brown, obovoid, apex obtuse, tapered to base, one septate; wall smooth.

In leaves of *Diapensia lapponica* L., known only from the type collection.

This small species is unusual in habit for the genus, but the large-celled peridium and ascospore shape and pigmentation permit of no other disposition. It must be rare, for I have seen only one collection, and B. Eriksson (1974) does not report any such species.

Dothidotthia fruticola (Ellis & Everh.) Barr, **comb. nov.** Figs. 6, 7

Parodiella fruticola Ellis & Everh. J. Mycol. 4: 97. 1888.

Plowrightia fruticola Ellis & Everh. in F. W. Anderson, J. Mycol. 5: 84. 1889.

Otthia fruticola (Ellis & Everh.) Ellis & Everh. North Amer. Pyrenomyc. 250. 1892.

Otthia clematidis Earle in Greene, Pl. Bakerianae 1: 13. 1901.

Ascomata immersed erumpent in long rows, globose or ovoid, 275-550 μm diam, 550-660 μm high, apex rounded, papilla inconspicuous; surface dull, rough with short hyphae and protruding cells; peridium ca. 50 μm wide, up to 165 μm at base, composed of brown, pseudoparenchymatous cells, with ample brown hyphal subiculum surrounding base and lower sides. Asci 115-160 x 20-22 µm. Ascospores 26-39 x 10-12(-15.5) µm, yellowish brown to light brown, ellipsoid, tapered to acute ends, 1-(2-)septate, not constricted at septum.

In stems of *Clematis ligusticifolius* Nutt., also known on *Sambucus* sp., western North America.

Material examined: BRITISH COLUMBIA: Soda Creek, 9 Jun 1951, J. Bancroft (UBC 2335). MONTANA: Sand Coulee, 11 Feb 1888, F. W. Anderson 124 (NY, holotype of *P. fruticola*, 2 packets), also as NAF 2129 (MASS, NY). COLORADO: Gulch between Sheep and Humboldt Peak, Sangre de Christo Range, 9 Jul 1888, C. H. Demetrio 212 (NY as *Dothidea insculpta*); Fort Collins, Apr 1894, C. F. Baker (NY), Jun 1894, F. Col. 718 (NY); 21 Mar 1896, C. F. Baker (NY as *O. clematidis*); Durango, 19 Mar 1899, C. F. Baker 4 and Pl. Southern Colorado 41 (NY, holotype of *O. clematidis*); Fort Garland, 27 Jun 1907, F. E. & E. S. Clements, Crypt. Form. Colorad. 432 (NY as *O. clematidis*).

Dothidotthia fruticola has larger ascospores than *D. aspera* and more ovoid ascomata. Most of the collections cited above bear also *Dothidea insculpta* Wallr. = *Scirrhia insculpta* (Wallr.) Barr (Barr, 1972). This species forms shining, multiloculate ascomata containing numerous small locules. The European and Asian *Otthia lisae* (de Not.) Sacc. is similar in ascospore shape and sizes and in the sterile base of ovoid ascomata. That species probably belongs in *Dothidotthia* also, but the ascomata have a three-layered peridium (Müller and von Arx, 1962).

Dothidotthia lasioderma (Ellis & Everh.) Barr, **comb. nov.**
Figs. 8, 9

Leptosphaeria lasioderma Ellis & Everh. Proc. Acad. Nat. Sci. Philadelphia 45: 135. 1893.

Gibberidea symphoricarpi Tracy & Earle in Greene, Pl. Bakerianae 1: 28. 1901.

Herpotrichia symphoricarpi (Tracy & Earle) Barr in L. Holm, Svensk Bot. Tidskr. 62: 239. 1968.

Ascomata erumpent separately or in small groups, globose or nearly so, 450-550 µm diam, 400-500 µm high, apex rounded with short papilla; surface clothed with short to elongate, brown, septate hyphae, mostly recumbent, forming limited fringe of subiculum around base; peridium 28-33 µm wide, of brown pseudoparenchymatous cells 5-8 µm wide. Asci 100-120 x 16.5-20 µm. Ascospores 24-33(-38) x (6-)7.5-11 µm, light reddish brown, oblong ellipsoid, tapered to less pigmented obtuse ends, usually slightly curved, 3-septate, slightly constricted; wall smooth or finely verruculose.

In woody branches of *Artemisia*, *Symphoricarpos*, western North America.

Material examined: COLORADO: Bob Creek W of Mt. Hesperus, 27 Jun 1898, C. F. Baker, Pl. Southern Colorado 173 (NY, holotype *G. symphoricarpi*, 2 packets). NEVADA: Sprucemont, Oct 1892, M. E. Jones 2 (NY, holotype *L. lasioderma*).

I am indebted to Dr. J. Boise for the suggestion that *Leptosphaeria lasioderma* could provide the earlier name. Despite the presence of hyphal appendages on the ascomata, other aspects, i.e., the large pseudoparenchymatous cells composing the peridium and ascospore shape, are congruent with species of *Dothidotthia*. Both L. Holm (1968) and Barr (1984) expressed reservations about placing *G. symphoricarpi* in *Herpotrichia*. The redisposition of this species removes a disparate element from *Herpotrichia* sensu str.

Dothidotthia quercicola (Ellis & Everh.) Barr, **comb. nov.** Figs. 10, 11

Otthia quercicola Ellis & Everh. North Amer. Pyrenomyc. 250. 1892.

Ascomata erumpent, densely gregarious on stout stromatic base, dull black, 220-330 µm diam, apex rounded, minutely papillate, slightly depressed around papilla; peridium ca. 30-40 µm wide at sides and over apex, up to 120 µm at base, composed of reddish brown, pseudoparenchymatous cells, 8-10 µm wide, with coarse reddish brown hyphae into substrate. Asci 70-80 x 18-20 µm. Ascospores 20-24 x 9-10(-11) µm, light clear brown, obovoid, apex obtuse, tapered to obtuse base, 1-septate, not or slightly constricted; wall smooth.

Causing some hypertrophy in small twigs of *Quercus alba* L., New Jersey, known only from type collection.

Material examined: NEW JERSEY: Newfield, 30 Jan 1880, J. B. Ellis 630 (NY, holotype).

This species is close in sizes to the midwestern and western collections of *D. aspera*. The more obovoid and less symmetric ascospores and some hypertrophy of the host serve to distinguish *D. quercicola*.

Dothidotthia ramulicola (Peck) Barr, Mycotaxon 29: 503. 1987. Figs. 14, 15

Sphaeria ramulicola Peck, Ann. Rep. New York State Mus. 25: 104. (for 1871) 1873.

Leptosphaeria ramulicola (Peck) Sacc. Syll. Fung. 2: 26. 1883.

Neodeightonia ramulicola (Peck) Barr in Barr et al. Bull. New York State Mus. 459: 39. 1986.

Didymosphaeria accedens Sacc. in Fairman, Proc. Rochester Acad. 48. 1890.

Microthelia accedens (Sacc.) O. Kuntze, Rev. Gen. Pl. 3: 498. 1898.

Didymosphaeria vagans Ellis & Everh. Proc. Acad. Nat. Sci. Philadelphia 45: 446. 1893.

Microthelia vagans (Ellis & Everh.) O. Kuntze, Rev. Gen. Pl. 3: 498. 1898.

Valsaria magnoliae Ellis & Everh. J. Mycol. 10: 170. 1904.

Ascomata gregarious to crowded with sides grown together at times, immersed beneath periderm, becoming erumpent in rows or groups, at times separate, globose or sphaeroid, (200-)300-450(-550) µm diam, 220-330(-385) µm high; apex rounded or short papillate; peridium 35-50(-104) µm wide, surrounded by ample coarse, dark brown hyphae. Asci 75-120(-155) x 14-30 µm, at times only 4-spored. Ascospores (15-)18-25(-34) x (8-)10-13(-16) µm, dark brown, ellipsoid, oblong or subglobose, ends rounded, (0-)1-(2-) septate, not or scarcely constricted; wall smooth or verruculose, surrounded by gel coating at times.

Anamorph: *Diplodia*-like: Conidiomata similar to and intermixed with ascomata; conidia (10-)15-23 x (5-)7.5-10.5 µm, brown, broadly ellipsoid, one celled or one septate.

In twigs and branches of various woody angiosperms (*Carya, Ceanothus, Fraxinus, Magnolia, Menispermum, Ostrya, Ulmus*), eastern North America with occasional collections from midwestern or western states.

Material examined: ONTARIO: London, 5 May 1893, J. Dearness (NY with *Fenestella princeps*); London, 30 May 1893, J. Dearness 2110, 2113B and 31 May, 2113 (NY, syntypes of *D. vagans*); Jul 1893 (NY, as *D. vagans*); Nov 1903, F. Col. 2100 (MASS, as *Valsaria magnoliae*). MASSACHUSETTS: Conway, 8 Feb 1962, Barr 3181 (MASS); Baptist Hill, Conway, 30 Dec 1979, Barr 6658 (MASS). NEW YORK: Greenbush, May 1871, C. H. Peck (NYS, holotype *Sphaeria ramulicola*), sine data (NYS); Lyndonville, May 1889, C. E. Fairman (NY, isotype *D. accedens*). IOWA: Ledges State Park, Boone Co., 25 Jun 1982, M. E. Barr 6940 (MASS). CALIFORNIA: Claremont, Los Angeles Co., 12 Mar 1911, C. F. Baker & Metz (NY on Pl. S. California 5382 of *Thyridium tuberculatum* Rehm and *Valsa ceanothi* Rehm).

Occasionally the ascospores may develop several additional septa, both transverse and longitudinal, although these septa do not become as dark or conspicuous as the original one. The anamorphic state is associated with the teleomorph in the type collection as well as in several other collections on *Ulmus*. In culture, Barr 6658 produced slow-growing dark colonies in which conidiomata developed. Conidiogenesis was holoblastic. The conidia were brown, mostly one septate, 10-12(-18) x 5-8 µm. On *Magnolia* and on *Menispermum* similar conidiomata are also present.

Dothidotthia ramulicola seems to be a dark and septate-spored counterpart to *Botryosphaeria obtusa*. In that species ascomata show similar variations in size, and in formation of papilla, and ascospores are (18-)22-27(-34) x 7-12(-15) µm, but remain hyaline and one celled. Conidia (*Sphaeropsis* sp., Shoemaker, 1964) are 22-26 x 10-12 µm, one celled or one septate and brown.

I acknowledge with gratitude the curators of herbaria (BPI, NY, NYS, UBC) whose loans of specimens made this study possible. Dr. J. Boise reviewed the manuscript, and I thank her for her suggestions.

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MYCOTAXON

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MARINE FUNGI FROM SEYCHELLES. VIII. RHIZOPHILA MARINA, A NEW ASCOMYCETE FROM MANGROVE PROP ROOTS

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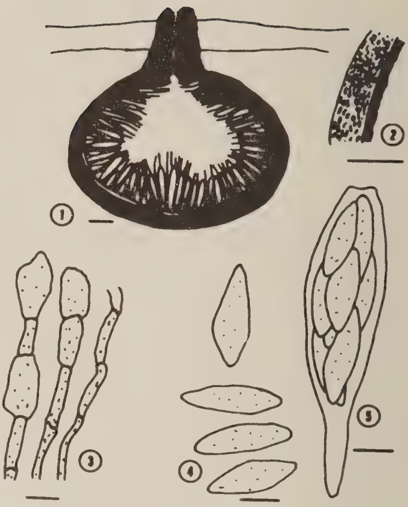
The number of marine fungi known from mangrove habitats has increased as many new species have recently been described (Kohlmeyer, 1984; Kohlmeyer & Schatz, 1985; Hyde & Borse, 1986a,b; Hyde & Jones, 1986; Kohlmeyer & Vittal, 1986). In this paper a new manglicolous fungus from proproots and branches of *Rhizophora mucronata* Lam. is described. *Rhizophila marina* gen. et sp. nov. is characterised as having one-celled ascospores without appendages, unitunicate asci without an apical apparatus and large thick-walled ascocarps which are immersed in the substratum.

RHIZOPHILA gen. nov.

Ascocarpii grandii, globosi vel subglobosi, in ligno immersi, ostiolati, papillati, periphysati, coriacei, fusci ad nigri, solitarii vel gregarii. Cum paraphyses *Asci* octospori, clavati, pedunculati, unitunicati, leptodermi cum apice incrassatulo, sine apparatu apicali, ex base et lateribus ascocarporum muri evolventes. *Ascosporae* 2-3 seriatae, ellipsoideae vel fusiformae, unicellulares, flavidae vel fulvae. *Substratum* in ligno mortuo mangrovis. *Typus Rhizophila marina* Hyde & Jones sp. nov.

Ascocarps large, globose to subglobose, immersed in the substratum, ostiolate, papillate, periphysate, coriaceous, dark brown to black, solitary or gregarious. Paraphyses-like structures irregular in morphology, septate. *Asci* 8-spored, clavate, pedunculate, unitunicate, thin-walled with an indistinct apical thickening, without an apical apparatus, developing from ascogenous tissue lining the base and sides of the ascocarp wall. *Ascospores* 2-3 seriate, ellipsoidal or fusiform, one-celled, yellowish to yellowish brown. *Substrate* intertidal mangrove roots. *Type species Rhizophila marina* Hyde and Jones sp. nov. *Etymology* From the Latin *Rhizophilus*, meaning growing on roots, in relation to the habitat of the genus.

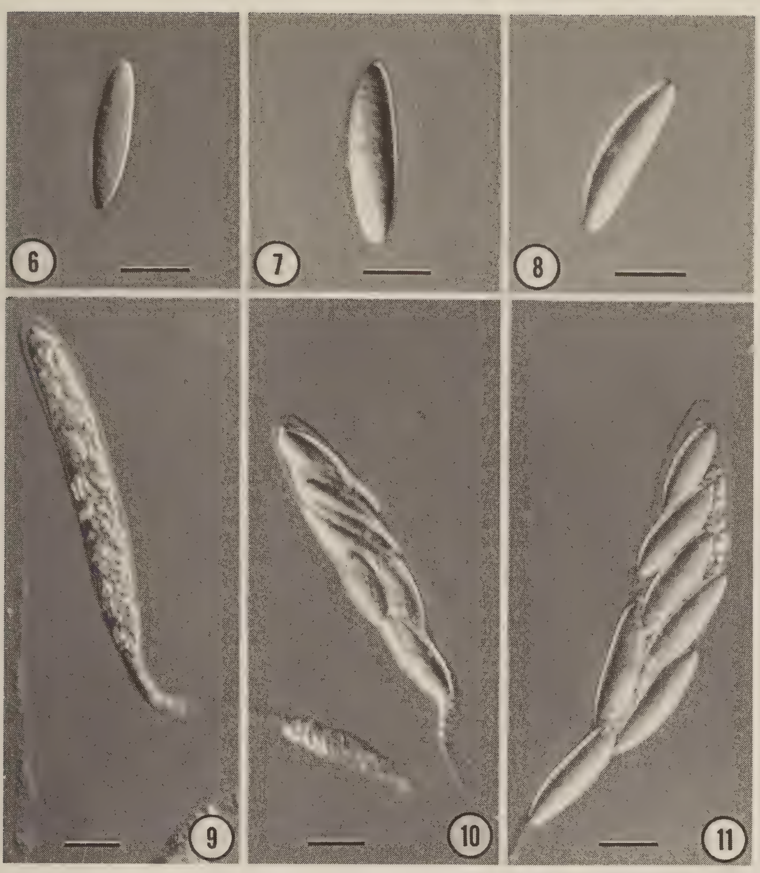


RHIZOPHILA MARINA HYDE et JONES sp. nov.

Ascocarpii 500-965 µm lati, 425-730 µm longi, globosi vel subglobosi, immersi, ostiolati, papillati, periphysati, coriacei, fusci vel nigri, solitarii vel gregarii. *Peridium* 45-112 µm crassum, 2-stratum, stratum externum, crassum, cum pigmento nigro, cum hyphum irregularibusque; stratum internum, leptodernum, hyalinum, ex cellulis leptodermis elongatis irregularibusque compositum. *Collum* ad per 515 µm longum x 113-198 µm latum, nigrum. Cum paraphyses. *Asci* 74-101 µm longi x 13-24 µm lati, octospori, clavati, pedunculati, unitunicati, leptodermi, subtruncati, sine apparatu apicali, ex base et lateribus ascocarporum muri orientes. *Ascosporae* 20-28 x 7-10 µm, 2-3 seriatae, ellipsoideae ad fusiformes, unicellulares, hyalinae cum immaturae, flavidae ad fulvas cum maturae. *Colonae* in SW/CMA, albae, floccosae, celeriter crescentes, sine ascocarpis evolventibus. *Substrata* radices et rami *Rhizophorae mucronatae*.

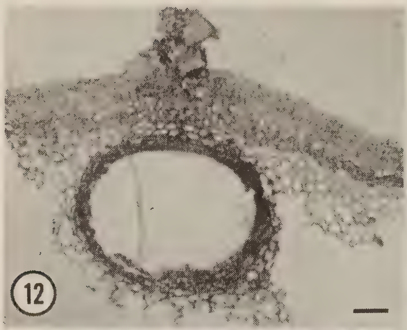
RHIZOPHILA MARINA HYDE et JONES sp. nov. (Figs 1-17).

Ascocarps 500-965 µm in diameter, 425-730 µm high, globose to subglobose, immersed, ostiolate, papillate, periphysate, coriaceous, dark brown to black, solitary or gregarious. *Peridium* 45-112 µm thick, 2-layered; the



Figs. 1-17. *Rhizophila marina*. Figs. 1-5. Diagrammatic representation of: 1. Cross section through ascocarp; 2. Peridium; 3. Paraphyses-like structures; 4. Ascospores and 5. Ascus. Figs. 6-15. Light micrographs. 6-8. One-celled ascospores. 9-11. Asci at various stages of development. Note the truncate ascus tip in 11 and the paraphyses-like structures in 9 and 10. Bar lines 1, 2 = 100μm; 3-11 = 10μm.

outer layer, thick, composed of a highly melanised layer of irregular hyphae interdispersed at the outside with the host cells, the inner layer, thin, hyaline, composed of irregular thin-walled elongate cells which fuse with the paraphyses-like structures. Necks up to 515μm long x 113-198μm in diameter, black, of similar structure to the ascocarp outer wall layer. Paraphyses-like structures, 3-11μm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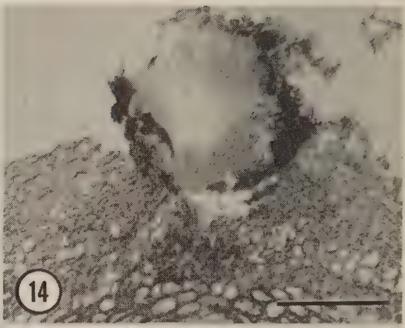
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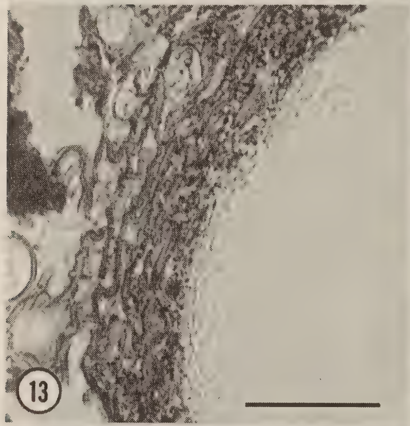
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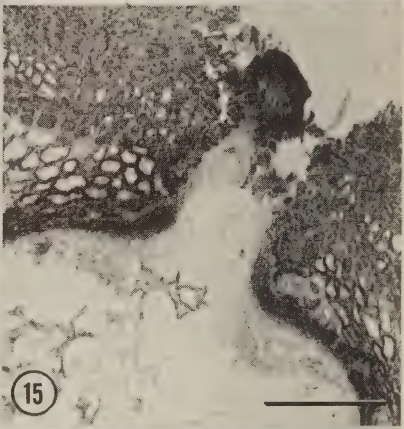
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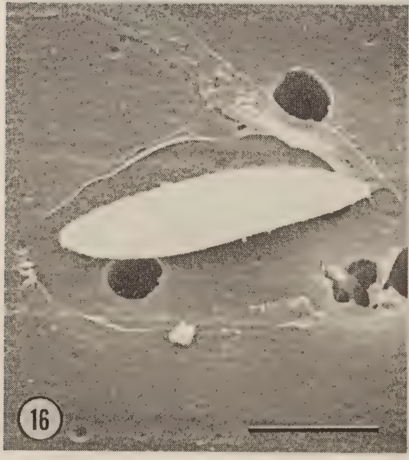
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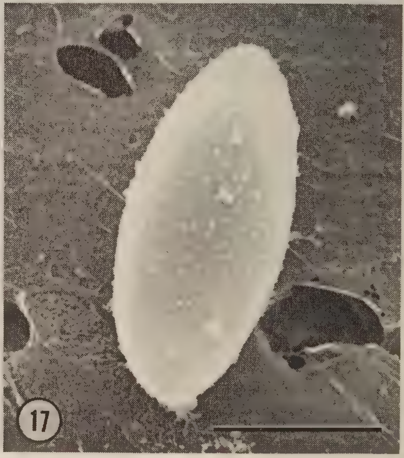
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12. T.S. Ascocarp; 13. Peridium. Note the inner wall layer (arrowed); 14, 15. Neck of ascocarp with periphyses. Figs. 16, 17. S.E.M. of ascospores which have a granular wall. The mucilaginous material on the polycarbonate membrane surface may be the remains of the paraphyses-like structures. Bar lines 12-15 = 100µm, 16, 17 = 10 µm.

wide, consisting of irregular shaped cells, septate. *Asci* 74-101 µm long x 13-24 µm in diameter, 8-spored, 2-3 seriate, clavate, pedunculate, unitunicate, thin-walled with an indistinct apical thickening, slightly truncate, without an apical apparatus, developing from ascogenous tissue lining the base and sides of the ascocarp wall. *Ascospores* 20-28 x 7-10 µm, ellipsoidal to fusiform, one-celled, hyaline when immature, yellowish to yellowish-brown at maturity. *Colonies* on SW/CMA white, floccose, fast growing, no fruiting structures developing. *Substrate* prop roots and branches of *Rhizophora mucronata* collected from Brillant mangrove, Seychelles. *Distribution* Indian Ocean (Seychelles), South China Sea (Brunei), Straits of Malacca (North Sumatra, Thailand), Pacific Ocean (Bali).

Holotype: Rhizophila marina January 5th, 1984, from the Seychelles. Herb. IMI.325411, slides 1-10.

Isotype: Dried wood from the Seychelles.

Etymology: From the Latin *marinus* = marine, describing the habitat of the species.

Other material examined: Intertidal roots of *Rhizophora* sp., Kpg. Serasa mangrove, Brunei, KDH0001, KDH0016, KDH 0046; Intertidal prop roots of *Rhizophora* sp., Kpg. Nelayan mangrove (near Belawan), North Sumatra, KDH0227; Intertidal prop roots of *R. mucronata*, Phang Nga Bay, Thailand, 14/1/88, KDH0926; Intertidal prop roots of *R. apiculata* Blume, Kuta Beach mangrove, Bali, 5/2/88, KDH1069, 1010.

Rhizophila marina cannot be assigned to any family of the Ascomycotina with any certainty, although it has affinities with the Phyllochoraceae and may well belong here. However, unlike members of this family, the ascocarps have thick walls and the asci lack a narrow apical annulus. *Rhizophila* shares many characteristics with the genus *Glomerella* Spauld & V. Schrenk, but differs in that the peridial wall in *Glomerella* is composed of angular cells, as opposed to irregular hyphae, is one layered rather than two and the ascospores are hyaline as opposed to yellow or brown. Species of *Glomerella* also generally develop in leaf tissue and often under a stroma, but the extent of stromatic development varies (v. Arx & Müller, 1954).

Rhizophila may also be included in the Gnomoniaceae; however, the fungus has paraphyses-like structures and asci lack an apical ring-like structure, characteristics inconsistent with members of this family.

Rhizophila is characterised by having yellowish-brown one-celled ascospores without appendages, and clavate unitunicate asci. Ascocarps are large, thick-walled, coriaceous, black, periphysate and with paraphyses-like structures. The fungus differs from any previous marine species known to us and because of its ubiquity in mangrove material is described as a new species.

R. marina was collected in the Seychelles on 50 occasions from mangrove prop roots and branches collected at Brillant and Anse Boileau mangroves. It was noted as Ascomycete sp. (4) in previous publications (Hyde, 1985, 1986; Hyde and Jones, 1988) and was regarded as a common species in the mangrove ecosystem. It has also been collected from Kpg. Serasa mangrove, Brunei, Kpg. Nelayan mangrove, North Sumatra, Phang Nga Bay, Thailand and Kuta Beach mangrove, Bali, Indonesia. It has been identified from *Rhizophora mucronata* and *Rhizophora apiculata* prop roots. *R. marina* was identified on material that was submerged during high tide and was associated with marine borers, barnacles, seaweeds and other marine fungi (i.e. *Lulworthia grandispora* Meyers, *Keissleriella blepharospora* Kohlmeyer & Kohlmeyer).

ACKNOWLEDGEMENTS

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MARINE FUNGI FROM INDIA. III. ACROCORDIOPSIS PATILII GEN. ET. SP. NOV. FROM MANGROVE WOOD

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During investigations into the mangrove inhabiting fungi from the coast of Maharashtra (India) and Brunei, an ascomycete with large black conical ascocarps was encountered. A new genus is described to accommodate this fungus which cannot be assigned to any genera of the Ascomycotina.

ACROCORDIOPSIS gen. nov.

Ascocarpiis concis vel semiglobosis, superficialibus, solitariis vel gregariis, nigris, ostiolatis, carbonaceis. Pseudoparaphysibus numerosis, filiformibus, persistentibus, anastomosantibus, septatis. Asci octosporis, bitunicatis, cylindricis, pedunculatis. Ascosporis hyalinis, uniseptatis constrictus, ad septis, ovoideis vel ellipsoideis, guttulatis. Typus generis: *Acrocordiopsis patilii* Borse et Hyde.

Ascocarps conical or semiglobose, superficial, solitary or gregarious, black, ostiolate, carbonaceous. Pseudoparaphyses numerous, filiform, persistent, anastomosing, septate. Asci eight-spored, bitunicate, cylindrical, pedunculate, with ocular chamber. Ascospores hyaline or slightly yellow, one-septate, constricted at the septum, obovoidal or ellipsoidal, guttulate. Type species: *Acrocordiopsis patilii* Borse et Hyde.

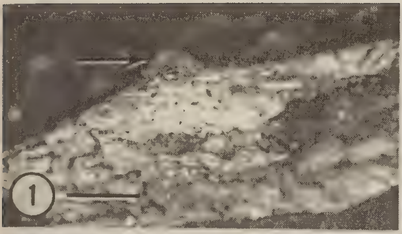
Etymology: *Acrocordiopsis* in reference to the congruity with the genus *Acrocordia* Massal.

ACROCORDIOPSIS PATILII sp. nov. (Figs 1-10)

Ascocarpiis 1-3mm latis, 1-2mm longis, conicis vel semiglobis, superficialibus, solitariis vel gregariis, nigris, ostiolatis, carbonaceis. Peridiis 240-350μm crassis. Pseudoparaphysibus hyalinis, filiformibus, persistentibus, numerosis, septatis, anastomosantibus. Ascis 150-250μm longis, 12-16μm latis, octosporis, bitunicatis, cylindricis, pedunculatis. Ascosporis 16-25μm longis, 10-16μm latis, hyalinis, uniseptatis, constrictis ad septis, ovoideis vel ellipsoideis, guttulatis. Substratum lignum mortuum *Avicenniae albae* Bl. et *Rhizophorae mucronatae* Lam. Holotypus: I.M.I. 297769.

Ascocarps 1-3mm in diameter x 1-2mm high, conical or semiglobose, superficial, solitary or gregarious, black, ostiolate, carbonaceous. Peridium 250-350μm thick, two layered; outer layer 240-338μm, thick, black, pseudoparenchymatous, composed of thick-walled black cells; inner layer 9-14μm thick, hyaline-light brown, merging with pseudoparaphyses, composed of irregular elongate thin-walled cells. A third area of rectangular thick-walled cells, brown in colour, fills the angle between the cover and basis of the ascoma. Pseudoparaphyses 0.5-1.5μm, hyaline, filiform, persistent, numerous, anastomosing and sparsely septate. Asci 150-250 x 12-16μm, eight spored, bitunicate, cylindrical, pedunculate, with an apically thickened refractive region and an ocular chamber, developing from base and corners of the ascocarp. Ascospores 16-25 x 10-16μm, hyaline, one septate, constricted at the septum, ovoidal or ellipsoidal, one large guttule per cell. Substratum on intertidal wood of *Avicennia alba* Bl. and *Rhizophora mucrobata* Lam.

Figs 1-10. *Acrocordiopsis patilii*: light micrographs. 1, 2. Conical ascocarps with released spore mass (arrowed). 3. Section through ascocarp. The wall is black, carbonaceous and individual cells are indistinguishable in mature specimens. A pallisade-like area of parallel cells is present at the rim. 4. Gregarious ascocarps. 5,6. Squash showing asci, filiform pseudoparaphyses and ascospores. Note the ocular chamber of the ascus and refractive apical thickening (5 arrowed). 7-10. Ascospores. Bars: Figs. 1,2,4 = 1mm; Fig. 4 = 500μm; Figs. 5-10 = 10μm.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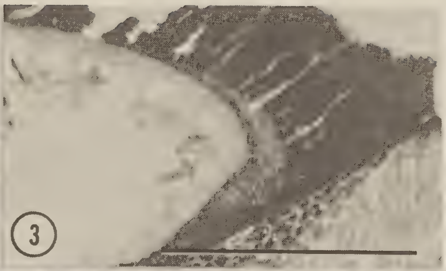
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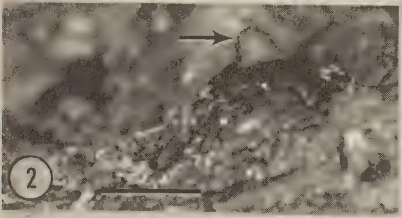
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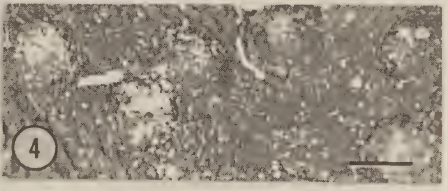
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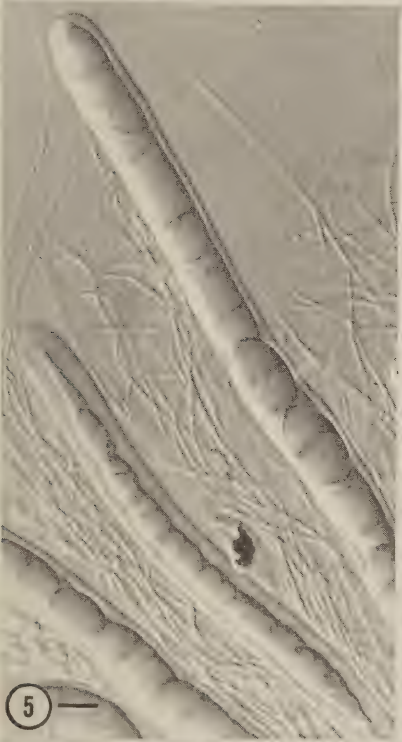
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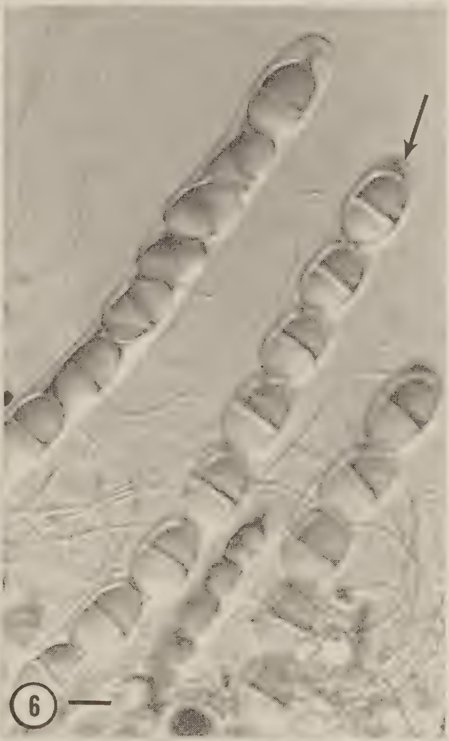
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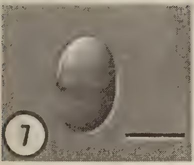
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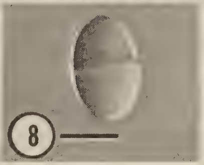
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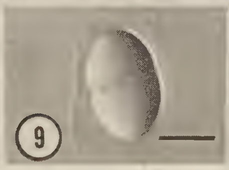
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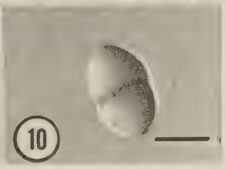
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Holotype: collected from Malvan (Maharashtra), Indian Ocean (India), 30.10.1981 on intertidal wood of *Avicennia alba* Bl. I.M.I. 297769.

Specimens examined: MFM No. 58, 30.4.1982, on intertidal wood of *Avicennia alba*; MFM No. 59, Bankot, 29.3.1983, on intertidal wood of *Rhizophora mucronata* Lam; MRM No. 60, Malvan, 18.4.1983, on intertidal wood of *Avicennia alba*; KDH 0071, October 1985, on mangrove wood, Brunei.

Attempts to locate a suitable genus to accommodate this mangrove species were unsuccessful and therefore a new genus *Acrocordiopsis* is formed to accommodate this taxon. *Acrocordiopsis* is characterized by having large conical superficial ascocarps (Figs 1-4), with a thick carbonaceous wall, narrow anastomosing hamathecial tissue (Figs 5,6) and cylindrical asci with an ocular chamber and a refractive apical thickening (Figs 5,6). Ascospores are hyaline, symmetrical, bi-celled and without appendages (Figs 7-10). These characteristics indicate that *Acrocordiopsis* can be placed in the Melanommatales (*sensu* Barr, 1983), Dothideales or Pyrenulales (*sensu* Hawksworth and Eriksson, 1986).

Acrocordiopsis may belong in the Pyrenulaceae (Pyrenulales) where it has affinities with *Acrocordia* Massal and *Acrocordiella* O. Eriksson (*Requinella* Fabre?). However, *Acrocordia* is a lichen forming genus and the asci are capped by a meniscus staining in Congo Red (Eriksson, 1981). The meniscus does not occur in *Acrocordiopsis*, although the tip of the ascus is thickened and refractive. In *Acrocordiella* (bark saprophyte), the ascospores are multiseptate with lenticular locules, the asci also have a meniscus (manubrium), while the ascocarps are immersed (Eriksson, 1982). In *Acrocordiopsis*, the ascocarp wall structure is also different from the above species.

Acrocordiopsis also has affinities with the genus *Peridiothelia* Hawksw. (Phaeosphaeriaceae), a non-lichenized saprophytic (?) genus (Hawksworth, 1985). However, *Acrocordiopsis* cannot be accommodated here as in *Peridothelia*, the pseudoparaphyses are cellular and blue in iodine, the ascocarps are smaller and the ascospores are brown (Hawksworth, 1985).

Acrocordiopsis is probably best included in the Melannommataceae (Melanommatales - *sensu* Barr, 1983;

Dothideales - *sensu* Hawksworth and Eriksson, 1986), since the ascocarps are ostiolate and possess a well developed hamathecium of the narrow, branched and anastomosing sparsely septate trabeculate type. It has affinities with the genus *Astrosphaeriella* Sydow (Hawksworth, 1981) although ascospores in these genera differ greatly. In *Acrocordiopsis* the ascocarp wall is composed of thick-walled black cells which are indistinguishable in mature specimens, while at the rim an area of pallisade-like rows of parallel cells is present. This type of wall structure is also found in *Astrosphaeriella*, while the ascocarps are also conical. However, ascospores differ in *Astrosphaeriella* as they are elongate-fusiform, usually brown or red-brown and surrounded by a gelatinous sheath when young (Hawksworth, 1981). Furthermore *Astrosphaeriella* species develop on monocotyledon petioles.

Acrocordiopsis patilii was collected in Brunei and India in the upper intertidal region of mangroves. The ascocarps are large (1-3mm high x 1-2mm long) compared to most fungi from marine or brackish water habitats; other marine species with large superficial ascocarps include *Rosellinia* sp. (undescribed ascomycete) and *Caryosporella rhizophorae* Kohlmeyer, and both species are known from mangrove habitats. It is also interesting to note that many very large spored ascomycetes have been collected from the mangrove habitat, which is an unusual feature for marine ascomycetes. *Aigialus grandis* Kohlm., *A. parvus* Kohlm., *Cucullospora mangrovei* Hyde and Jones and *Halosarpheia ratnagiriensis* Patil and Borse all have ascospores with dimensions above 55μm. *Lulworthia grandispora* is the largest *Lulworthia* sp. and this is also found in mangrove habitats.

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NEW SPECIES IN THE LICHEN GENUS XANTHOPARMELIA (ASCOMYCOTINA: PARMELIACEAE)

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Abstract: The following new species in the lichen genus *Xanthoparmelia* from North and South America, Australia, Lesotho, South West Africa/Namibia, and South Africa are described as new: *X. afrolavicola* Hale, *X. amplexuloides* Hale, *X. ausiana* Hale, *X. catarinae* Hale, *X. cirrhomedullosa* Hale, *X. coneruptens* Hale, *X. conjuncta* Hale, *X. granulata* Hale, *X. harrisii* Hale, *X. idahoensis* Hale, *X. imbricata* Hale, *X. inflata* Hale, *X. khomasiana* Hale, *X. kotisephola* Hale, *X. lipochlorochroa* Hale & Elix, *X. luderitziana* Hale, *X. mapholanengensis* Hale, *X. maxima* Hale, *X. neowyomingensis* Hale, *X. norcolorata* Hale, *X. norlobaronica* Hale, *X. norwalteri* Hale, *X. protolusitana* Hale, *X. protoquintaria* Hale, *X. psornorstictica* Hale, *X. pustulosorediata* Hale, *X. salamphixantha* Hale, *X. saleruptens* Hale, *X. salkiboensis* Hale, *X. springbokensis* Hale, *X. subamplexuloides* Hale, *X. subbullata* Hale, *X. subconvoluta* Hale, *X. subluminosa* Hale, *X. submougeotii* Hale, *X. substenophylloides* Hale, and *X. tsekensis* Hale.

Xanthoparmelia afrolavicola Hale, sp. nov. (Figs. 1, 2)

Thallus laxe adnatus, fragilis, 5–7 cm latus, lobis sublinearibus, 1.5–4 mm latis, superne continuus, emaculatus, isidiatus, isidiis cylindricis, subtus pallide brunneus, sparse rhizinosus.

Thallus loosely adnate on rock, rather brittle and easily breaking apart, 5–7 cm broad, darkish yellow green; lobes subirregular to sublinear, 1.5–4 mm wide, irregularly dichotomously branched, subimbricate; upper surface continuous to faintly white maculate in patches, shiny, moderately to densely isidiate, the isidia cylindrical, thin, 0.06–0.08 mm in diameter, 0.1–0.4 mm high, black tipped, unbranched or sparingly branched (fig. 2); lower surface plane, light brown, sparsely rhizinate, the rhizines pale brown, coarse, simple, 0.2–0.5 mm long. Pycnidia common; conidia cylindrical, 0.5 × 5–6 μm. Apothecia lacking.

Chemistry: psoromic, norpsoromic, usnic acids.

Type collection: Natal Table Mountain near Pietermaritzburg, elev. 650 m, Natal Province, South Africa, Grid 2930 DA, *Hale* 74104 (US, holotype; PRE, isotype).

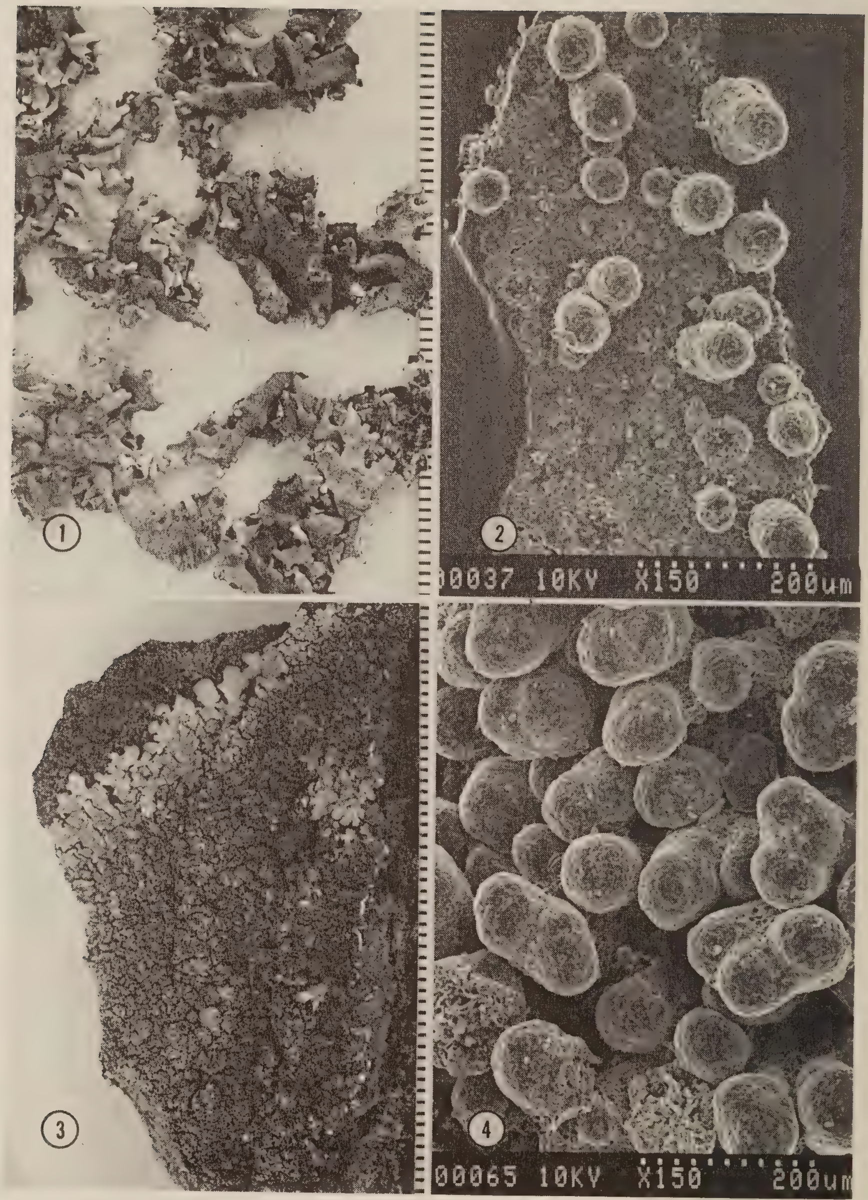
Additional specimens examined. S.W.A./Namibia: Waterberg Plateau National Park (E of Otjiwarongo), Grid 2017 AC, *Hale* 80923, 80984, 81048, 81058 (US).

This rare species is related to the American psoromic acid-containing *X. lavicola* (Gyel.) Hale, which has globose, partially erumpent isidia and a darker, moderately rhizinate lower surface.

Xanthoparmelia amplexuloides Hale, sp. nov. (Figs. 3,4)

Thallus adnatus, saxicola, 5–8 cm latus, lobis subirregularibus, 1.2.5 mm latis, superne continuus, emaculatus, modice isidiatus, isidiis subglobosis, subtus planus, brunneus, modice rhizinosus.

Thallus adnate, rather soft and fragile, 5–8 cm broad, light yellowish green to yellowish green; lobes subirregular, 1–2.5 mm wide, apically subrotund and irregularly branched, imbricate; upper surface continuous, shiny, rugose with age, moderately to densely isidiate, the isidia initially subglobose, subcylindrical at maturity, 0.08–0.12 mm in diameter, to 0.5 mm high, tips syncorticate to weakly epicorticate, pale, very rarely erumpent or breaking off, unbranched (fig. 4); lower surface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Figures 1–4. Species of *Xanthoparmelia*: 1, *X. afrolavicola* (*Hale* 74104, holotype); 2, SEM enlargement of isidia of *X. afrolavicola*; 3, *X. amplexuloides* (*Hale* 78874, holotype); 4, SEM enlargement of isidia of *X. amplexuloides*. Scale in mm.

plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.4 mm long. Pycnidia lacking. Apothecia substipitate, 1–2 mm in diameter; spores 5–6 × 9–11 μm.

Type collection: 38 km W of Bloemfontein on north side of Hwy R64, elev. 1500 m, Orange Free State, South Africa, Grid 2926 BA, *Hale* 78874, 3 Nov. 1986 (US, holotype; PRE, isotype).

Chemistry: norlobaridone, unknown Rfc 12, and usnic acid (det. J. A. Elix).

Additional specimens examined. South Africa. Transvaal: Hanglip Forest Reserve, Soutpansberg Mountains, Grid 2229 DD, *Hale* 76373 (US); Breedtsnek, Magaliesberg, Grid 2527 CD, *Hale* 80871, 80876 (US); Long Tom Pass, Grid 2530 BA, *Hale* 76070 (US). Orange Free State: 46.9 km S of Wepener, Grid 3027 AA, *Hale* 73483, 73484 (US); 38.5 km S of Standerton, *Hale* 73481 (US). Cape Province: 33.8 km W of Dordrecht, Grid 3126 BC, *Hale* 73480, 73482 (US); Penhoek Pass on Hwy R30, Grid 3126 BC, *Hale* 80558 (US); 20 km WSW of Elliott, Grid 3127 BC, *Hale* 72531 (US); 27.6 km WNW of Elliott, Grid 3127 BA, *Hale* 77087 (US); 17.9 km NE of Maclear, Grid 3028 CD, *Hale* 76891 (US); 37.4 km NW of Queenstown, Grid 3126 AC, *Hale* 72530 (US); Karoo Nature Reserve, Grid 3224 BC, *Hale* 73479 (US). Natal: Mzintlava River crossing on Hwy R394, 22km N of Kokstad, Grid 3029 AD, *Hale* 81316 (US); Giants Castle Game Reserve, Grid 2929 BC, *Hale* 80811 (US). Lesotho: 6 km S of Sehlabathebe National Park, Grid 2929 CC, *Hale* 81347, 81349, 81354 (US); 9 km W of Ramatsiliso Nek, Grid 3028 BB, *Hale* 81354 (US).

The Australian *X. amplexula* is a more robust, leathery lichen with branched, tall, black-tipped cylindrical isidia and usually contains loxodin along with norlobaridone and rarely the scabrosin complex. *Xanthoparmelia scabrosa* (Tayl.) Hale, common in Australasia and Japan, has distinctly pustulate isidia. Another isidiate, norlobaridone-containing species in S.W.A./Namibia, *X. subamplexuloides* Hale (below), is tightly adnate with narrow lobes, 0.4–1.3 mm wide.

Xanthoparmelia ausiana Hale, sp. nov. (Fig. 5)

Thallus arcte adnatus, saxicola, 4–8 cm latus, lobis subirregularibus, 1–2 mm latis, superne continuus, emaculatus, isidiis sorediisque destitutus, subtus pallide brunneus, modice rhizinosus.

Thallus tightly adnate to adnate on rock, somewhat dispersed, 4–8 cm broad, light yellow green; lobes subirregular, 1–2 mm wide, short and irregularly branched, separate to subimbricate; upper surface continuous to faintly maculate in patches, shiny, rugulose and transversely cracked with age, isidia and soredia lacking; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.3–0.5 mm long. Pycnidia commonly developed; conidia bifusiform, 0.5 × 5–6 μm. Apothecia lacking.

Chemistry: norstictic, salazinic and usnic acids.

Type: On sheltered granite ledge, 5 km NE of Aus on hwy 35 (road to Helmeringshausen), 4.7 km N of Hwy B4, elevation 1300 m, South West Africa/Namibia, Grid 2616 CB, *Hale* 81143, 27 April 1988 (US, holotype; PRE, isotype).

The thallus color and lobe configuration remind one of *X. colorata* (Müll. Arg.) Hale, a much larger lichen with the same chemistry but a black lower surface.

Xanthoparmelia catarinae Hale, sp. nov. (Figs. 6, 7)

Thallus laxe adnatus, saxicola, 5–8 cm latus, lobis sublinearibus, 0.8–2 mm latis, superne modice isidiatus, isidiis subglobosis vel irregulariter cylindricis, subtus niger, sparse rhizinosus.

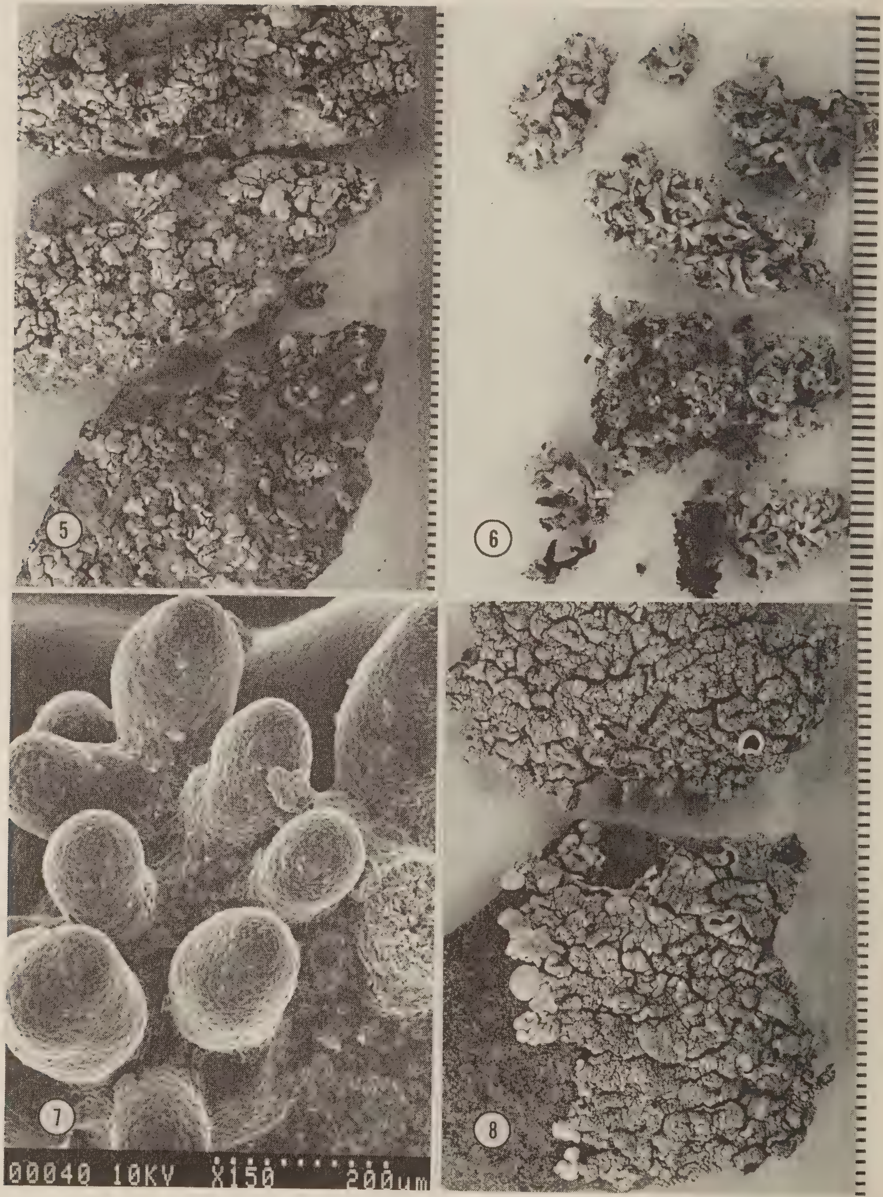
Thallus loosely adnate on rock, brittle, 5–8 cm broad, yellowish green; lobes sublinear, 0.8–2 mm wide, dichotomously branched, imbricate; upper surface continuous, shiny, sparsely to moderately isidiate, the isidia initially subglobose, irregularly cylindrical at maturity, 0.14–0.18 mm in diameter, 0.2–0.8 mm high, mostly simple to sparsely coralloid branched (fig. 7); lower surface plane to weakly convoluted at the tips, black with a barely raised dark to yellowish rim, shiny, sparsely rhizinate, the rhizines black, coarse, unbranched, 0.2–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 μm. Apothecia lacking.

Chemistry: stictic, constictic, norstictic, cryptostictic (tr.) and usnic acids.

Type collection: Florianopolis-Estreito, Santa Catarina, Brazil, *Poeschmann-Hajkova* in *Vezda, Lichenes Selecti Exsiccati* 761 (US, holotype).

Additional specimen examined. South America. Brazil. Sao Sepe, Passo dos Freire, Rio Grande do Sul, *Fleig* ICN 55973 (US).

This is an isidiate species related to *X. hypopsila* (Müll. Arg.) Hale, a common nonisidiate lichen in Argentina. It is differentiated from North American *X. isidiascens* by the subconvolute lobe tips, narrower lobes, and sparse rhizines.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Figures 5 – 8. Species of *Xanthoparmelia*: 5, *X. ausiana* (*Hale* 81143, holotype); 6, *X. catarinae* (*Poeschmann-Hajkova*, holotype); 7, SEM enlargement of isidia of *X. catarinae*; 8, *X. cirrhomedullosa* (*Hale* 80605, holotype). Scale in mm.

Xanthoparmelia cirrhomedullosa Hale, sp. nov. (Fig. 8)

Thallus adnatus, saxicola, 5–7 cm latus, lobis subirregularibus, 1–4 mm latis, superne albo-maculatus, rugosus, isidiis sorediisque destitutus, medulla pro parte ochracea, subtus brunneus, modice rhizinosus.

Thallus adnate on sheltered rock, leathery, 5–7 cm broad, darkish yellow green; lobes subirregular with rotund tips, 1–4 mm wide, short, contiguous at the margin, crowded at the center; upper surface uniformly white maculate, shiny, strongly rugose with age; isidia and soredia lacking; lower surface plane, brown or faintly orange, smooth to rugulose, sparsely to moderately rhizinate, the rhizines brown, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 μm. Apothecia substipitate, 2–4 mm in diameter.

Chemistry: salazinic and usnic acids, skyrin and the chalybaeizans unknown.

Type collection: Large S-facing Cave sandstone ledges, Greyling Pass on W side of Hwy R396, 9 km N of Rossouw, elev. 2100 m, Cape Province, South Africa, Grid 3127 AB, *Hale* 80605, 6 April 1988 (US, holotype; PRE, isotype).

The white maculate surface and medullary pigment skyrin are found only in this species and in *X. subcolorata* Hale, a large, sublinear-lobed, loosely adnate lichen with an eroding lower surface. It is known only from the type collection.

Xanthoparmelia coneruptens Hale, sp. nov. (Fig. 9)

Thallus arcte adnatus, saxicola, 3–5 cm latus, lobis subirregularibus, 0.5–1 mm latis, superne continuus vel vix reticulato-maculatus, pustulatus, pustulis eruptentibus, crasse sorediatis, subtus planus, pallide brunneus, modice rhizinosus.

Thallus tightly adnate on rock, light yellowish green, 3–5 cm broad; lobes subirregular, 0.4–1 mm wide, short and crowded, imbricate; upper surface continuous to faintly reticulate-maculate, shiny to dull white pruinose with age, transversely cracked, pustulate-isidiate, the pustules entire or erupting, breaking open and become coarsely sorediate; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, ca 2 mm long. Pycnidia and apothecia lacking.

Chemistry: lecanoric and usnic acids.

Type collection: On overhanging sandstone ledge, on Hwy R364, 32.4 km S of jct with R27, elev. 600 m, Cape Province, South Africa, Grid 3119 CD, *Hale* 79859, 24 March 1988 (US, holotype; PRE, isotype).

Additional specimens examined. South Africa. Cape Province: same locality as the holotype, *Hale* 79854, 79855, 79859 (US); 7 km W of Oliewenboskraal (W of Hwy N7), Grid 3218 BD, *Hale* 79906 (US); 18 km E of Aggeneys on Hwy R64, Grid 2918 BB, *Hale* 79474, 79475 (US).

This is a chemotype of *X. eruptens* Hale, in fact the commonest member of this pustulate-isidiate group, typically found on the underside of large overhanging sandstone ledges.

Xanthoparmelia conjuncta Hale, sp. nov. (Fig. 10)

Thallus arcte adnatus, saxicola, coriaceus, 4–6 cm latus, lobis subirregularibus, 0.7–1.5 mm latis, superne continuus, emaculatus, isidiis sorediisque destitutus, subtus planus, brunneus, modice rhizinosus.

Thallus tightly adnate to adnate on rock, leathery, 4–6 cm broad, dark yellowish green; lobes subirregular, 0.7–1.5 mm wide, irregularly branched, contiguous to subimbricate; upper surface continuous, transversely cracked with age, isidia and soredia lacking; lower surface plane, brown, moderately rhizinate, the rhizines brown, simple, 0.2–0.4 mm long. Apothecia adnate, 1–3 mm in diameter. Pycnidia common; conidia bifusiform, 0.5 × 4–6 μm.

Chemistry: diffractaic (major), 4-O-demethyldiffractaic, barbatic (tr.), 4-O-demethylbarbatic (tr.), and usnic acids.

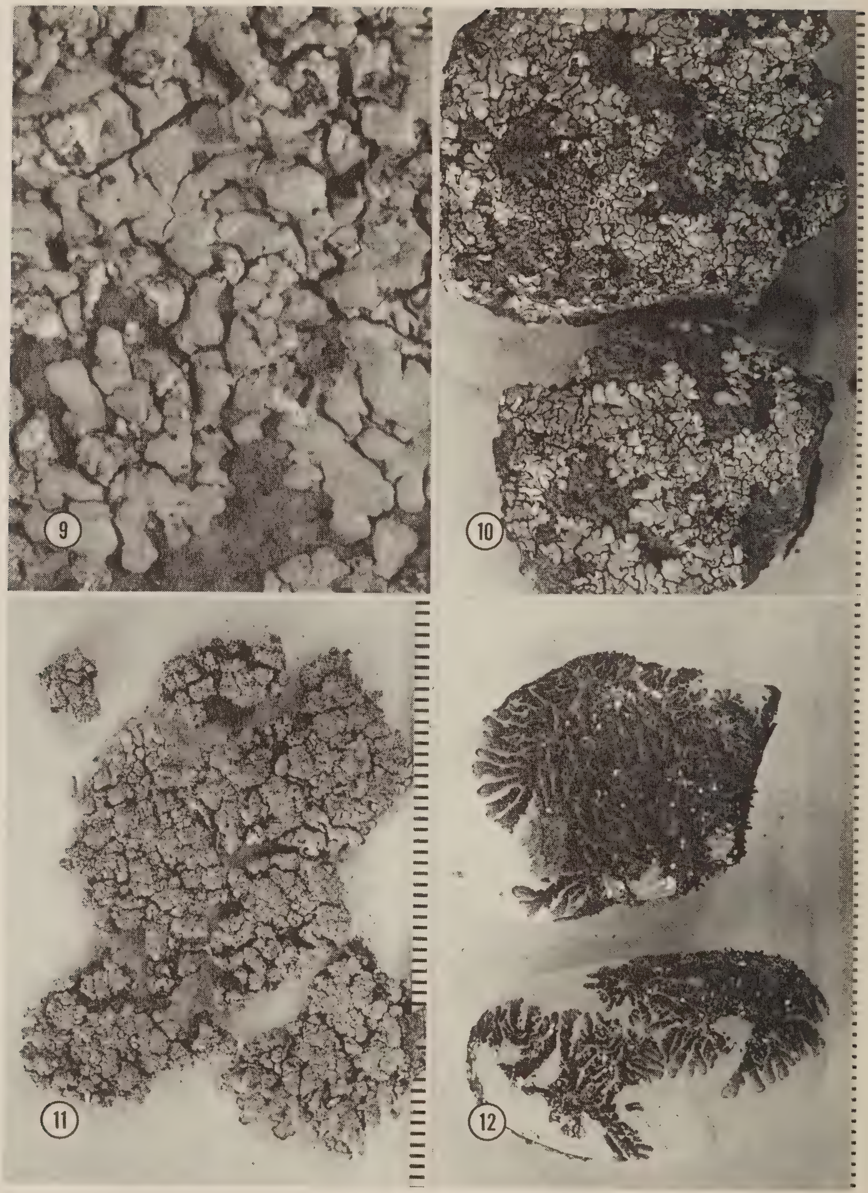
Type collection: On small dolerite boulders in meadow, 2.6 km NW of Sani Pass, elev. 2900 m, Lesotho, Grid 2929 DB, *Hale* 81327, 6 May 1988 (US, holotype; PRE, isotype).

This rare high elevation species is externally similar to *X. lesothoensis* Hale, which contains both diffractaic and salazinic acids but lacks 4-O-demethyldiffractaic acid.

Xanthoparmelia granulata Hale, sp. nov. (Fig. 11)

Thallus adnatus, saxicola, fragilis, 4–6 cm latus, lobis subirregularibus, 0.8–1.3 mm latus, superne continuus, emaculatus, valde rugosus, pustulatus, pustulis eruptentibus, crasse sorediatis, subtus planus, pallide brunneus, sparse rhizinosus.

Thallus adnate on rock (removed free when wetted), fragile and breaking into pieces, dull



Figures 9–12. Species of *Xanthoparmelia*: 9, *X. coneruptens* (*Hale* 79859, holotype (×10)); 10, *X. conjuncta* (*Hale* 81327, holotype); 11, *X. granulata* (*Hale* 81540, holotype); 12, *X. harrisii* (*Hale* 81203, holotype). Scale in mm.

yellowish green, 4–6 cm broad; lobes subirregular, 0.8–1.3 mm wide, black rimmed, subimbricate; upper surface continuous, dull to faintly pruinose, soon strongly rugose, the wrinkles becoming irregularly pustulate, erupting and forming coarse soredia; lower surface plane, pale brown, sparsely to moderately rhizinate, the rhizines simple, 0.3–0.5 mm long. Pycnidia and apothecia lacking.

Chemistry: fumarprotocetraric, succinprotocetraric, and usnic acids.

Type collection: On sheltered dolerite ledge, 56.1 km N of Mapholaneng on Sani Pass-Moteng Pass road, elev. ca 3000 m, Lesotho, Grid 2828 DD, *Hale* 81540, 7 May 1988 (US, holotype; PRE, isotype).

The granular pustules are vaguely similar to those of *Flavoparmelia caperata* (L.) Hale, but the narrow lobes and pale lower surface are typical of *Xanthoparmelia*. It is known only from the type collection at high elevation in Lesotho.

Xanthoparmelia harrisii Hale, sp. nov. (Fig. 12)

Thallus arcte adnatus, saxicola, 1–2 cm latus, lobis sublinearibus, 0.5–1 mm latis, superne sparse isidiatus, isidiis cylindricis, subtus pallide brunneus, sparse rhizinosus

Thallus tightly adnate on quartz pebbles, light yellow green at the tips but darkening to blackish brown at the center, 1–2 cm broad; lobes sublinear, 0.5–1 mm wide, convex, little branched, separate to contiguous; upper surface continuous, dull and light pruinose, sparsely to densely isidiate, the isidia coarse, cylindrical, 0.1–0.2 mm in diameter, to 2 mm high, the tips syncorticate, becoming richly branched; lower surface plane, pale brown, sparsely rhizinate, the rhizines short, coarse, 0.1–0.2 mm long, unbranched. Pycnidia and apothecia lacking.

Chemistry: hypostictic, hyposalazinic, hypoconstictic, caperatic (±) and usnic acids, associated undetermined spots.

Type collection: Gravel flats, 18.2 km NE of Cape Cross on E side of Hwy D2301, elev. 100 m, S.W.A./Namibia, Grid 2113 DB, *Hale* 81203, 22 April 1988 (US, holotype; LD, PRE, isotypes).

Additional specimens examined. S.W.A./Namibia: East of Wlotzska's Baken off Hwy D2301, Swakopmund District, Grid 2214 AD, *Hale* 80946 (US), *R. Harris* 18513 (NY); 33.1 km NE Cape Cross at "Pink Mountain," Grid 2114 CA, *Hale* 81023 (US);

Comments: This widespread, easily overlooked Namib desert lichen grows best on the protected lower edges of quartzite pebbles. The center is almost black but the marginal lobes a bright yellow. It is unique among the species with the hypostictic acid series and confined to the coastal fog zone in Namibia. It is named in honor of Dr. Richard Harris, who first collected it.

Xanthoparmelia idahoensis Hale, sp. nov. (Fig. 13)

Thallus vagans, terricola, coriaceus, 2–4 cm latus, lobis sublinearibus, 1.5–4 mm latis, contortis, subterete laciniatus, superne valde albo-maculatus, sorediis isidiisque destitutus, subtus canaliculatus, sparsissime rhizinosus.

Thallus vagrant, free growing on soil, firm, breaking apart when collected, 2–4 cm broad, light yellowish green; lobes sublinear, 1.5–4 mm wide, contorted and twisted, the tips irregularly dilated and divided into subterete black-tipped laciniae ca 0.5 mm wide, separate; upper surface strongly white maculate, shiny, soredia and isidia lacking; lower surface irregularly canaliculate with a raised rim, pale yellowish brown or turning brown toward the tips, foveolate-rugose, very sparsely rhizinate, the rhizines brown, coarse, 0.2–0.3 mm long, simple. Pycnidia and apothecia lacking.

Chemistry: salazinic, consalazinic, protocetraric (tr.), and usnic acids.

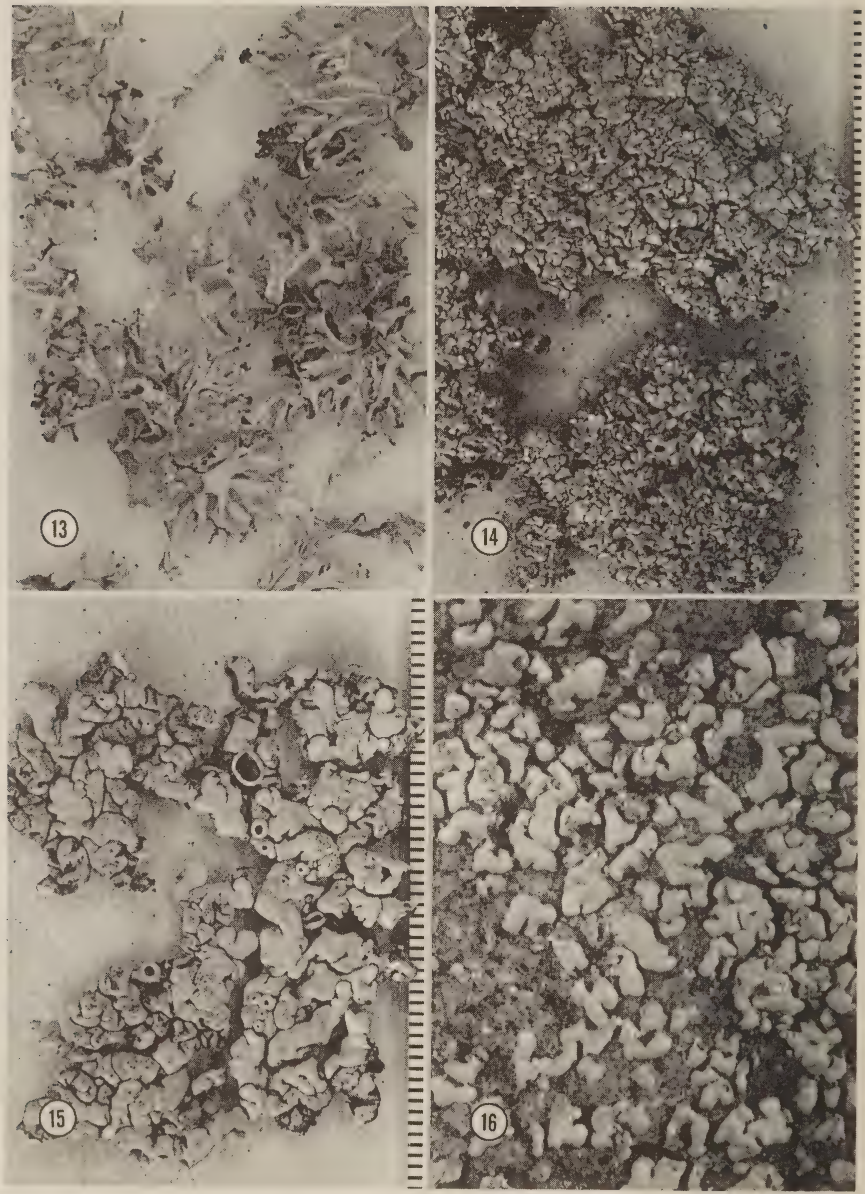
Type collection: On calcareous lacustrine ash soil, SE of Salmon, Lemhi County, Idaho, T 21 N, R 22 E, sect. 28, *R. Rosentreter* 3828, 4 Jan. 1986 (US, holotype; Rosentreter herbarium, isotype).

This rare soil lichen with contorted lobes is unique in the genus. The waxy-appearing upper surface is strongly maculate in patches. It almost seems like an *Evernia*, but with the scanning electron microscope I was able to find epicorticate areas.

Xanthoparmelia imbricata Hale, sp. nov. (Fig. 14)

Thallus laxe adnatus, saxicola, subpulvinatus, fragilis, 8–10 cm latus, lobis subirregularibus, 1–2 mm latis, apice digitato-laciniatis, superne continuus, emaculatus, isidiis sorediisque destitutus, subtus planus, nigricans, sparsissime rhizinosus.

Thallus loosely adnate on rock, subpulvinate, rather fragile and breaking apart, 8–10 cm broad, light yellowish green; lobes subirregular, 1–2 mm wide, short with digitate-laciniate branched tips, the tips black rimmed and often suberect and weakly subterete, strongly imbricated; upper surface continuous, shiny, isidia and soredia lacking; lower surface plane, dark brown at the tips with a



Figures 13 – 16. Species of *Xanthoparmelia*: 13, *X. idahoensis* (*Rosentreter* 3828, holotype); 14, *X. imbricata* (*Hale* 81541, holotype); 15, *X. inflata* (*Hale* 81531, holotype); 16, *X. khomasiana* (*Hale* 80955, holotype (×10)). Scale in mm.

yellowish rim, blackening at the center, very sparsely rhizinate, the rhizines black, simple, 0.4–0.8 mm long. Pycnidia numerous; conidia subbifusiform, 0.5 × 5–6 μm. Apothecia lacking.

Chemistry: unknown fatty acids Rfc 33 and 37 (in *X. subdecipiens*), constipatic (tr.), protoconstipatic (tr.), and usnic acids.

Type collection: On sheltered dolerite ledges on hillside, 56.1 km N of Mapholaneng on Sani Pass-Moteng Pass road, elev. ca 3000 m, Lesotho, Grid 2828 DD, *Hale* 81541, 7 May 1988 (US, holotype; PRE, isotype).

Additional specimen examined. Lesotho: 7.5 km NW of Sani Pass, Grid 2929 CB, *Hale* 81529 (US).

The digitate-laciniate lobes and chemistry set this species apart from other fatty acid-containing species.

Xanthoparmelia inflata Hale, sp. nov. (Fig. 15)

Thallus adnatus, saxicola, coriaceus, 5–10 cm latus, lobis late sublinearibus, 2–3 mm latis, convexis, superne continuus, emaculatus, isidiis sorediisque destitutus, subtus planus, dense rhizinosus.

Thallus adnate to loosely adnate on rock, rather leathery and appearing inflated, 5–10 cm broad, light yellowish green; lobes broadly sublinear, 2–3 mm wide, little branched, separate to contiguous; upper surface continuous, dull, rugose at the center, isidia and soredia lacking; lower surface plane, pale brown, densely rhizinate, the rhizines pale brown, simple to sparsely furcately branched, 0.5–1 mm long. Pycnidia numerous; conidia bifusiform, 0.5 × 6–7 μm. Apothecia well developed, substipitate, 3–7 mm in diameter; spores 5–6 × 9–10 μm.

Chemistry: Hypoprotocetraric, 4-O-demethylnotatic, and usnic acids.

Type collection: On small dolerite boulders on S-facing slope, east side of Kotisephola Pass, 11.3 km NW of Sani Pass, elev. 3200 m, Lesotho, Grid 2929 CB, *Hale* 81531, 6 May 1988 (US, holotype; PRE, isotype).

Additional specimens examined. Lesotho: Same locality as the holotype, *Hale* 81398 (US); Kotisephola Pass summit, Grid 2929 CA, *Hale* 81394 (US); E slope of Mahlasela Pass (S of Oxbow), Grid 2828 DC, *Hale* 81444 (US).

Xanthoparmelia inflata represents another member of the hypoprotocetraric acid-containing *X. prodomokosii* Hale & Elix group. The diagnostic features are the high elevation habitat and the puffy, little branched lobes. During the long winter season the species seems to be shaded and covered with hoarfrost or snow most of the time.

Xanthoparmelia khomasiana Hale, sp. nov. (Fig. 16)

Thallus arcte adnatus, saxicola, lobis subirregularibus, 0.3–0.8 mm latis, superne continuus, emaculatus, modice isidiatus, isidiis crassis, pustulatis, subtus planus, pallide brunneus, modice rhizinosus.

Thallus very tightly adnate on rock, 3–4 cm broad, dull yellowish green; lobes subirregular, 0.3–0.7 mm wide, short and irregularly branched, contiguous to subimbricate; upper surface continuous, shiny, sparsely isidiate, the isidia subglobose, 0.2 mm in diameter, to 0.2 mm high, the tips epicorticate, pale, hollow, pustular and erupting but without forming soredia; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, fragile, unbranched, 0.1–0.3 mm long. Pycnidia and apothecia lacking.

Chemistry: hypoprotocetraric, 4-O-demethylnotatic, and usnic acids.

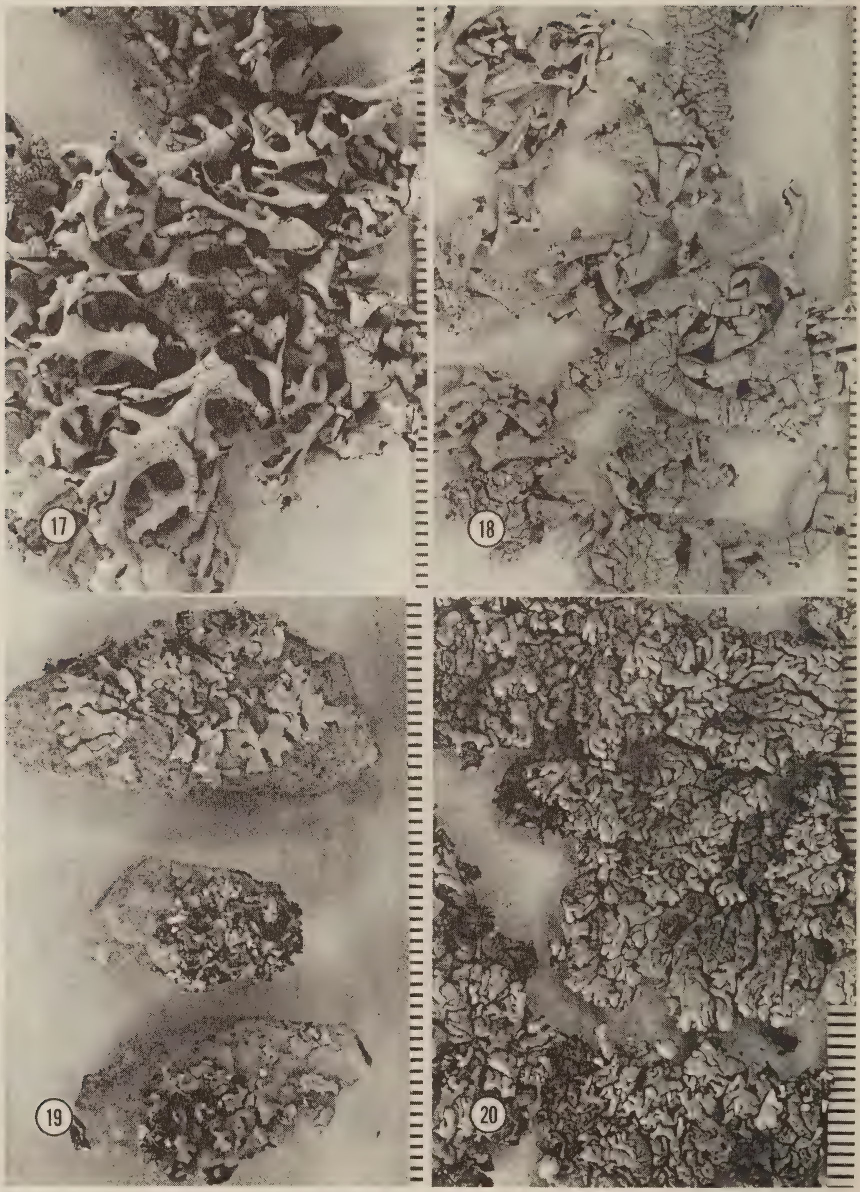
Type collection: Khomas Highlands, 47 km W of Windhoek on Hwy R56, 3.4 km W of Neu Heusis, S.W.A./Namibia, Grid 2216 DA, *Hale* 80955, 25 April 1988 (US, holotype; PRE, isotype).

This rare, easily overlooked species is related to the *X. weberi* (Hale) Hale group, but the isidia are strongly globose and the tightly adnate lobes much narrower.

Xanthoparmelia kotisephola Hale, sp. nov. (Fig. 17)

Thallus laxe adnatus, terricola, coriaceus, lobis sublinearibus, 1–3 mm latis, superne continuus, emaculatus, sorediis isidiisque destitutus, subtus convolutus, brunneus, dense rhizinosus.

Thallus loosely adnate to nearly free growing on soil, remaining mostly intact to scattered, firm and leathery, somewhat pulvinate, 4–12 cm broad, yellowish green or darkening; lobes sublinear, 1–3 mm wide, irregularly branched, separate to contiguous; upper surface continuous, shiny, irregularly cracked with age, isidia and soredia lacking; lower surface weakly to distinctly convoluted, pale brown to brown but darkening toward the tips, densely rhizinate, the rhizines brown or



Figures 17 – 20. Species of *Xanthoparmelia*: 17, *X. kotisephola* (*Hale* 79519, holotype); 18, *X. lipochlorochroa* (*Buckingham* S22115, holotype in HO); 19, *X. luderitziana* (*Hale* 80123, holotype); 20, *X. mapholanengensis* (*Hale* 81487, holotype). Scale in mm.

darkening, rather coarse and often projecting as a dense mat from below, simple, 0.5 – 1 mm long. Pycnidia poorly developed; conidia bifusiform, 0.5 × 5 – 6 μm. Apothecia lacking.

Chemistry: Salazinic, consalazinic, norstictic (tr.), protocetraric (tr.), and usnic acids.

Type collection: On grassy humus in pasture, summit of Kotisephola Pass, 13.8 km NW of Sani Pass, elev. 3240 m, Lesotho, Grid 2929 CA, *Hale* 79519, 6 May 1988 (US, holotype; ANUC, ASU, LD, PRE isotypes).

Additional specimens examined. Lesotho: Mahlasela Hill, elev. 3100 m, Lesotho, Grid 2828 DC, *Deal & Killick* 83, *Hale* 81495 (PRE, US); Black Mountain, Qachas Nek, *Kofler* 2 – 2 – 15a (LD, US).

This convoluted species occurs in the dolerite highlands of Lesotho, widely scattered among mats of short grasses. It is distinguished from the American *X. chlorochroa* (Tuck.) Hale by the dense mat of dark rhizines below and the open branching pattern.

Xanthoparmelia lipochlorochroa Hale & Elix, sp. nov. (Fig. 18)

Thallus vagans, terricola, coriaceus, 3 – 5 cm latus, lobis sublinearibus, separatis, superne continuus, emaculatus, sorediis isidiisque destitutus, subtus valde convolutus, sparse rhizinosus.

Thallus vagrant, free growing on soil, leathery, breaking apart into smaller colonies 3 – 5 cm broad, light yellowish green; lobes sublinear, 2 – 5 mm wide (to 10 mm when unrolled), sparsely branched, separate; upper surface continuous, shiny to mostly dull, transversely cracked and rugose with age, soredia and isidia lacking; lower surface strongly convoluted with little of the lower surface visible, light brown or darkening, smooth to foveolate-ridged, sparsely rhizinate, the rhizines brown, delicate, 0.3 – 0.6 mm long, simple. Pycnidia and apothecia lacking.

Chemistry: traces of unidentified fatty acids, usnic acid.

Type collection: On sandy soil, 15 mi S of Kammerer, Lincoln County, Wyoming, *B. J. Buckingham* S22115, in *Weber, Lichenes Exsiccati* 29 (HO, holotype; MEL, isotype).

This is a rare fatty acid chemotype of *X. chlorochroa*, a common western lichen with salazinic acid. I wish to thank Dr. J. A. Elix for bringing the species to my attention and determining the chemistry. The number of Weber's exsiccate in US contains salazinic acid and represents *X. chlorochroa* (Tuck.) Hale; the various duplicates in this widely distributed exsiccate must be retested for chemistry.

Xanthoparmelia luderitziana Hale, sp. nov. (Fig. 19)

Thallus laxe adnatus, saxicola, fragilis, 1 – 3 cm latus, lobis sublinearibus, 1 – 2 mm latis, apice adscendentibus, superne albo-maculatus, isidiis sorediisque destitutus, subtus planus, niger, pro parte flavo – marginatus, sparsissime rhizinosus.

Thallus loosely adnate on pebbles, rather brittle, 1 – 3 cm broad, dull yellowish green; lobes sublinear, 1 – 2 mm wide, separate to subimbricate with ascending tips; upper surface white maculate, shiny, transversely cracked with age, isidia and soredia lacking; lower surface plane, smooth to rugulose, black, shiny, in part yellow rimmed, very sparsely rhizinate, the rhizines black, coarse, 0.2 – 0.3 mm long. Pycnidia and apothecia lacking.

Chemistry: diffractaic (major), barbatic (tr.), squamatic (tr.), and usnic acids.

Type collection: On pebbles in loose granite-schist desert pavement, 9 km S of Lüderitz, elev. 20 m, South West Africa/Namibia, Grid 2615 CA, *Hale* 80123, 28 April 1988 (US, holotype; PRE, isotype).

Additional specimens examined. S.W.A./Namibia: Same locality as the holotype, *Hale* 80019 (US).

This rare species is closely related to *X. walteri* Knox, although the lobes are shorter and the thallus quite brittle. It occurs with *X. norwalteri* Hale (see below) on desert pavement well within the coastal fog zone.

Xanthoparmelia mapholanengensis Hale, sp. nov. (Fig. 20)

Thallus adnatus vel laxe adnatus, saxicola, coriaceus, 8 – 15 cm latus, lobis sublinearibus, 0.8 – 2 mm latis, convexis, sublaciniatis, apice subteretibus, superne continuus, emaculatus, isidiis sorediisque destitutus.

Thallus adnate to loosely adnate on rock, rarely on soil, rather firm, often forming a centrifugate pattern, 8 – 15 cm broad, light yellowish green; lobes sublinear, 0.8 – 2 mm wide, convex and in part appearing inflated, sublaciniate, the tips blunt, subterete, darkening, separate to subimbricate; upper surface continuous, shiny, transversely cracked with age, isidia and soredia lacking; lower surface plane, shiny, brown at the tips but blackening at the center, sparsely rhizinate, the rhizines brown to black, 0.2–0.4 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 μm. Apothecia lacking.

Chemistry: salazinic (major), protocetraric (major), norstictic (minor), consalazinic, and usnic acids.

Type collection: On vertical dolerite ledge face, 23.4 km N of Mapholaneng on the Sani Pass–Moteng Pass road, elev. 3100 m, Lesotho, Grid 2928 BB, *Hale* 81487, 7 May 1988 (US, holotype; LD, PRE, isotypes).

Additional specimens examined. Lesotho: Same locality as the holotype, *Hale* 81477, 81478 (US); 11.3 km NW of Sani Pass on the east slope of Kotisephola Pass, Grid 2929 CB, *Hale* 81533, 81535 (US); Kotisephola Pass, 13.4 km NW of Sani Pass, Grid 2929 CA, *Hale* 81395, 81427, 81428 (US);; 30.5 km N of Mapholaneng (1.5 km S of Letsengla), Grid 2928 BB, *Hale* 81537, 81539 (US); Mahlasela Pass (S of Oxbow), Grid 2828 DC, *Hale* 81497 (US); Moteng Pass, Grid 2828 DA, *Hale* 81555, 81557 (US).

This common high elevation species has a unique combination of acids, salazinic and protocetraric acids both forming strong spots on TLC plates, inflated, subterete lobes, and often a centrifugate growth pattern.

Xanthoparmelia maxima Hale, sp. nov. (Fig. 21)

Thallus laxe adnatus, saxicola, firmus, 6–9 cm latus, lobis subirregularibus, late apice rotundatus, 3–9 mm latis, superne continuus, emaculatus, pro parte pruinosus, isidiis sorediisque destitutus, subtus planus, pallide brunneus, modice rhizinosus.

Thallus loosely adnate on rock, leathery but breaking apart when collected, 6–9 cm broad, light yellowish green; lobes subirregular and broadly rotund, 3–9 mm wide, subimbricate; upper surface continuous, dull and in part white pruinose, rugose and transversely cracked with age, isidia and soredia lacking; lower surface plane, light brown, moderately to densely rhizinate, the rhizines pale brown, robust, simple to splayed or furcate, 0.5–1 mm long. Pycnidia numerous; conidia bifusiform, 0.5 × 5–6 μm. Apothecia well developed, substipitate, 2–5 mm in diameter, the disc becoming pruinose, rarely perforate, the rim usually inrolled.

Chemistry: norstictic, salazinic, consalazinic, and usnic acids.

Type collection: Mudstone outcrops along hwy R388, 32 km N of junction with R63 (S of Richmond), elev. 1400 m, Cape Province, South Africa, Grid 3124 CA, *Hale* 80651, 4 April 1988 (US, holotype; PRE, isotype).

Additional specimen examined. South Africa. Cape Province: Same locality as the holotype, *Hale* 80560 (US); on Hwy R388, 13 km N jct with Hwy R63 (S of Richmond), Grid 3124 CA, *Hale* 80617 (US).

The unusually broad lobes resemble those of chemically similar *X. colorata* (Gyel.) Hale, which is black below, as well as salazinic acid-containing *X. crassilobata* Hale, which grows on soil and is more convoluted.

Xanthoparmelia neowyomingica Hale, sp. nov. (Fig. 22)

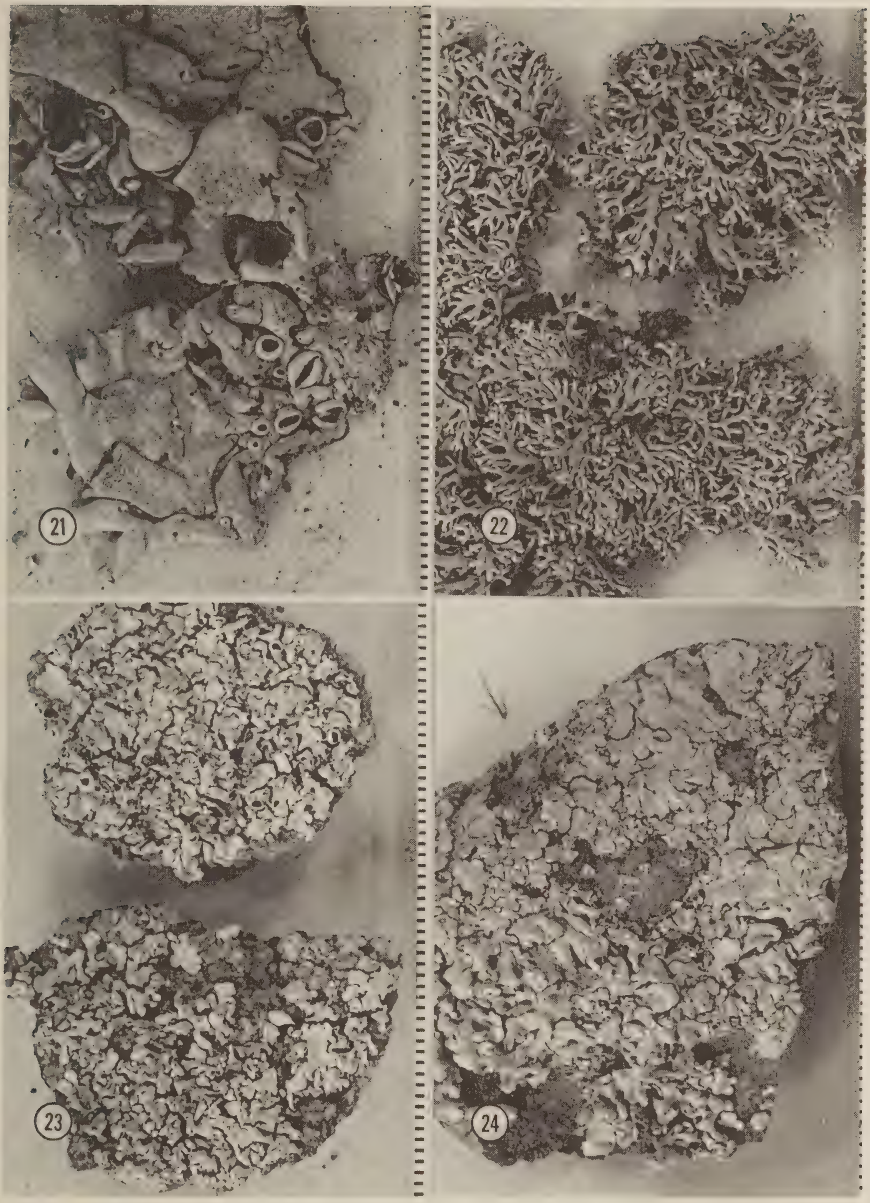
Thallus laxe adnatus, terricola, 3–4 cm latus, lobis sublinearibus, 0.8–2 mm latis, margine tereti-laciniatis, superne continuus, emaculatus, sorediis isidiisque destitutus, subtus pallide brunneus, dense rhizinosus.

Thallus loosely adnate to nearly free growing on soil, forming orbicular colonies 3–4 cm in diameter, firm, light yellowish green; lobes sublinear, 0.8–2 mm wide, dichotomously branched at the tips, subascending, soon marginally laciniate to form dense masses of weakly terete laciniae 0.3–0.6 mm wide; upper surface continuous, shiny, isidia and soredia lacking; lower surface convoluted with a more or less prominent raised yellowish rim, pale brown to brown, moderately to densely rhizinate, the rhizines pale brown or darkening, rather coarse with splayed tips, simple to branched and tufted, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 4–5 μm. Apothecia rare, substipitate, 2–4 mm in diameter; spores not developed.

Chemistry: stictic, constictic, norstictic, and usnic acids.

Type collection: 3 mi S of Ward, vicinity of Glacier Lake, Boulder County, Colorado, U.S.A., *Wirth* s.n., 1 June 1962 (US, holotype; COLO, isotype).

Except for the more conspicuous development of terete laciniae and the chemistry, this species is very close to another more common, salazinic acid-containing, high elevation soil lichen *X. wyomingica* (Gyel.) Hale.



Figures 21–24. Species of *Xanthoparmelia*: 21, *X. maxima* (*Hale* 80651, holotype); 22, *X. neowyomingica* (*Wirth* s.n., holotype in US); 23, *X. norcolorata* (*Hale* 81260, holotype); 24, *X. norlobaronica* (*Hale* 72523, holotype). Scale in mm.

Xanthoparmelia norcolorata Hale, sp. nov. (Fig. 23)

Thallus adnatus, saxicola, 6–8 cm latus, lobis subirregularibus, sublobulatis, 1–2 mm latis, superne continuus, emaculatus, isidiis sorediisque destitutus, subtus planus, niger, sparse rhizinosus.

Thallus adnate on rock, 6–8 cm broad, light yellowish green; lobes subirregular, 1–2 mm wide, rather short and crowded, subimbricate, sublobulate, becoming suberect and revolute at the center; upper surface continuous, dull, rugulose with age, isidia and soredia lacking; lower surface plane, black, sparsely rhizinate, the rhizines black, simple to sparsely branched, 0.3–0.6 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–8 μm. Apothecia substipitate, 1–2 mm in diameter; spores 5–6 × 9–10 μm.

Chemistry: norstictic, connorstictic, and usnic acids.

Type collection: On sheltered coarse granite in large koppie, 13.6 km N of Rehoboth on east side of Hwy B2, elev. 1700 m, South West Africa/Namibia, Grid 2317 AA, *Hale* 81260, 30 April 1988 (US, holotype; PRE, isotype).

This rare species seems to fall near the *X. colorata* (Gyel.) Hale (norstictic and salazinic acids present) group, but it is a smaller, narrow-lobed lichen without the additional salazinic acid.

Xanthoparmelia norlobaronica Hale, sp. nov. (Fig. 24)

Thallus adnatus vel laxe adnatus, saxicola, fragilis, 5–7 cm latus, lobis subirregularibus, 1–3 mm latis, superne continuus, emaculatus, sorediis isidiisque destitutus, subtus pallide brunneus, modice rhizinosus.

Thallus adnate to loosely adnate, fragmenting easily, 5–7 cm broad, light yellowish green; lobes subirregular, 1–3 mm wide, apically rotund, short and irregularly branched, imbricate; upper surface continuous, shiny, rugulose with age, soredia and isidia lacking; lower surface plane, pale brown, moderately rhizinate, the rhizines pale brown, simple, 0.2–0.5 mm long. Pycnidia well developed; conidia bifusiform, 0.5 × 4–6 μm. Apothecia lacking.

Chemistry: norlobaridone, unknown Rfc 12, usnic acid, several undetermined fatty acids (det. J. A. Elix).

Type collection: 3.8 km SW of Montagu in pass area on west side of road. Elev. 200 m. Cape Province, South Africa, Grid 3320 CC, *Hale* 72523, 3 Feb. 1986 (US, holotype; PRE, isotype).

Additional specimens examined. South Africa. Cape Province: Same locality as the holotype, *Hale* 72522 (US); 21.6 km S of Tarkastad on W side of Hwy R344, Grid 3226 AB, *Hale* 77367 (US).

This species is comparable to the Australasian *X. filarszkyana* (Gyel.) Hale, which is more closely adnate and normally contains loxodin in addition to norlobaridone.

Xanthoparmelia norwalteri Hale, sp. nov. (Fig. 25)

Thallus laxe adnatus, saxicola, fragilis, 1–3 cm latus, lobis sublinearibus, 1–2 mm latis, apice adscendentibus, superne albo-maculatus, transversim fissuratus, isidiis sorediisque destitutus, subtus planus, niger, flavo-marginatus, sparsissime rhizinosus.

Thallus loosely adnate on pebbles, rather brittle, 1–3 cm broad, dull yellowish green; lobes sublinear, 1–2 mm wide, separate to subimbricate with ascending tips; upper surface white maculate, shiny, transversely cracked with age, isidia and soredia lacking; lower surface plane, smooth to rugulose, black, shiny, in part yellow rimmed, very sparsely rhizinate, the rhizines black, coarse, 0.2–0.3 mm long. Pycnidia and apothecia lacking.

Chemistry: norstictic, connorstictic, and usnic acids.

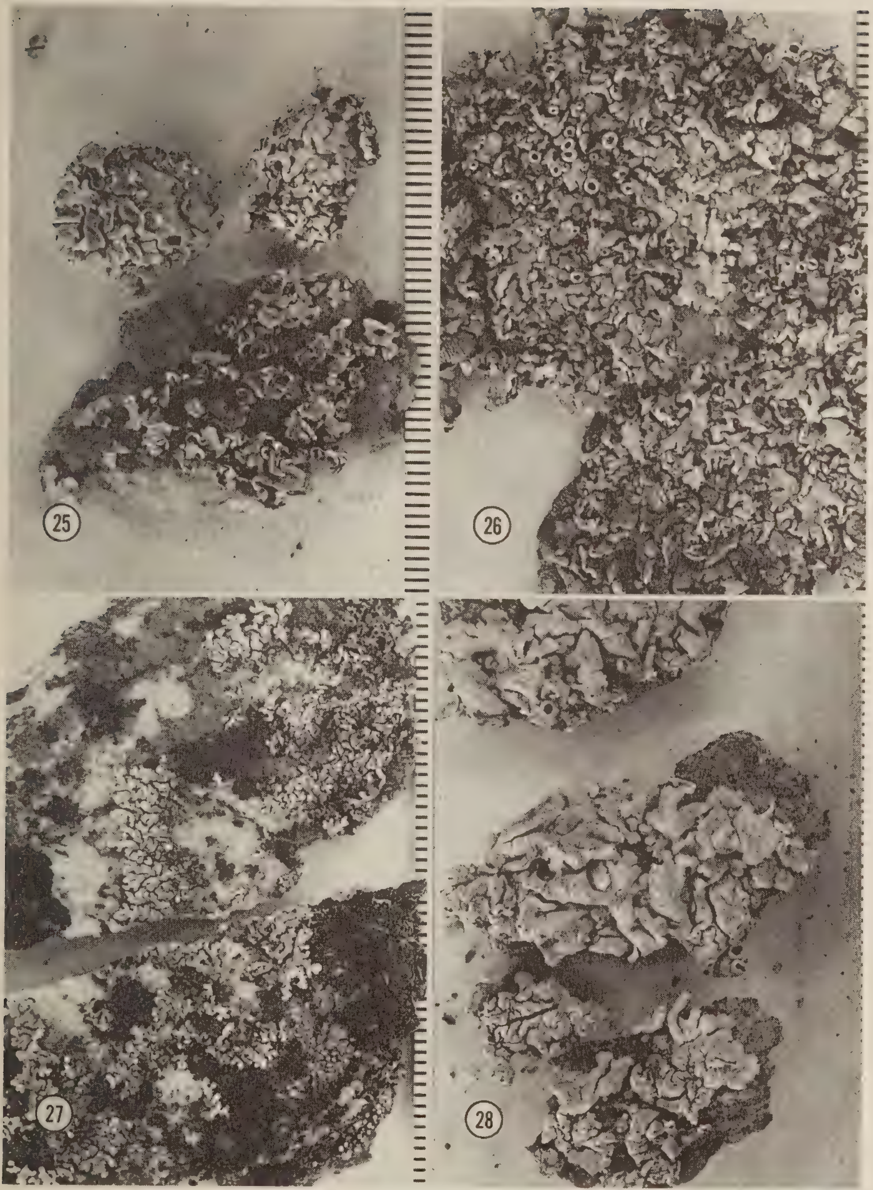
Type collection: 9 km S of Lüderitz, South West Africa/Namibia, Grid 2615 CA, *Hale* 81205, 28 April 1988 (US, holotype; PRE, isotype).

This unusual relative of *X. walteri* Knox occurs at the same locality as diffractaic acid-containing *X. luderitziana* Hale (see above). It is also smaller and more brittle than typical *X. walteri*.

Xanthoparmelia protolusitana Hale, sp. nov. (Fig. 26)

Thallus adnatus vel laxe adnatus, saxicola, firmus, 4–8 cm latus, lobis sublinearibus, 0.7–2 mm latis, laciniatis, superne continuus, emaculatus, isidiis sorediisque destitutus, subtus planus, niger, modice rhizinosus.

Thallus adnate to loosely adnate on rock, rather stiff, 4–8 cm broad, darkish yellow green; lobes subirregular to sublinear, 0.7–2 mm wide, imbricate, becoming laciniate, the laciniae sublinear, 0.2–0.4 mm wide, black rimmed; upper surface continuous, shiny, rugulose and sparsely transversely cracked with age, isidia and soredia lacking; lower surface plane, black and shiny, sparsely to



Figures 25–28. Species of *Xanthoparmelia*: 25, *X. norwalteri* (*Hale* 81205, holotype); 26, *X. protolusitana* (*Hale* 81205, holotype); 27, *X. protoquintaria* (*Hale* 78171, holotype); 28, *X. psomorstictica* (*Hale* 79495, holotype). Scale in mm.

moderately rhizinate, the rhizines black, simple, 0.3–0.5 mm long. Pycnidia lacking. Apothecia numerous, substipitate, 1–4 mm in diameter; spores not found.

Chemistry: stictic, constictic, and usnic acids, lusitana unknown.

Type collection: On low sandstone ledges along small stream, 9 km W of Ramatsiliso Nek, elev. 2400 m, Lesotho, Grid 3028 BB, *Hale* 81205, 28 April 1988 (US, holotype; PRE, isotype).

Additional specimens examined. Lesotho: Same locality as the holotype. *Hale* 81333 (US); 7.5 km NW of Sani Pass on road to Mokhotlong, Grid 2929 CB, *Hale* 81518 (US).

Although more or less related to *X. angustiphylla* (Gyel.) Hale, the thallus is rather stiff. The lack of norstictic acid and presence of the "lusitana" unknown (a faintly reacting yellowish spot below norstictic acid) suggest a closer relationship with isidiate *X. lusitana* (Nyl.) Krog & Swinscow.

Xanthoparmelia protoquintaria Hale, sp. nov. (Fig. 27)

Thallus arcte adnatus, saxicola, 2–4 cm latus, lobis sublinearibus, 0.4–0.9 mm latis, superne continuus, emaculatus, isidiis sorediisque destitutus, subtus planus, niger, modice rhizinosus.

Thallus tightly adnate on rock, 2–4 cm broad, darkish yellow green; lobes subirregular to sublinear, 0.4–0.9 mm wide, short, dichotomously branched, contiguous to subimbricate; upper cortex continuous, shiny, transversely cracked at the center, isidia and soredia lacking; lower surface plane, black, shiny, moderately rhizinate, the rhizines black, simple to furcate, 0.1–0.2 mm long. Pycnidia and apothecia lacking.

Chemistry: hypostictic, hyposalazinic, hypoconstictic, and usnic acids.

Type collection: On sandstone ledges in Fynbos, Fernkloof Nature Reserve at Hermanus, Cape Province, South Africa, Grid 3419 AD, *Hale* 78171, 25 Oct. 1986 (US, holotype; PRE, isotype).

The only other hypostictic acid-containing *Xanthoparmelia* with a black lower surface is the Australian *X. multipartita* (R. Br.) Elix, a loosely adnate, linear-lobed species.

Xanthoparmelia psornorstictica Hale, sp. nov. (Fig. 28)

Thallus laxe adnatus, saxicola, coriaceus, 5–7 cm latus, lobis subirregularibus, rotundatis, 1.5–3 mm latis, superne continuus, emaculatus, isidiis sorediisque destitutus, subtus planus, nigricans, modice rhizinosus.

Thallus adnate to loosely adnate on rock, firm and leathery, 5–7 cm broad, light yellowish green; lobes subirregular with rotund tips, 1.5–3 mm wide, relatively short and crowded; upper surface continuous, dull, rugulose with age, isidia and soredia lacking; lower surface plane, brown at the tips but black toward the center, sparsely to moderately rhizinate, the rhizines black, simple, 0.5–1 mm long. Pycnidia common; conidia bifusiform, 0.5 × 6–8 μm. Apothecia substipitate, 1–3 mm in diameter; spores 5–6 × 9–10 μm.

Chemistry: psoromic, norstictic, and usnic acids.

Type collection: On coarse granite outcrops in pasture, 18 km NE of Keimoes on S side of Hwy R27, elev. 900 m, Cape Province, South Africa, Grid 2821 CA, *Hale* 79495, 17 March 1988 (US, holotype; PRE, isotype).

Additional specimens examined. South Africa. Cape Province: Same locality as the holotype, *Hale* 79493, 79494 (US).

A narrow-lobed member of the *X. colorata* (Gyel.) Hale group, this species has a unique combination of acids. It was abundant at the type locality, an arid desert site, but has not been found elsewhere.

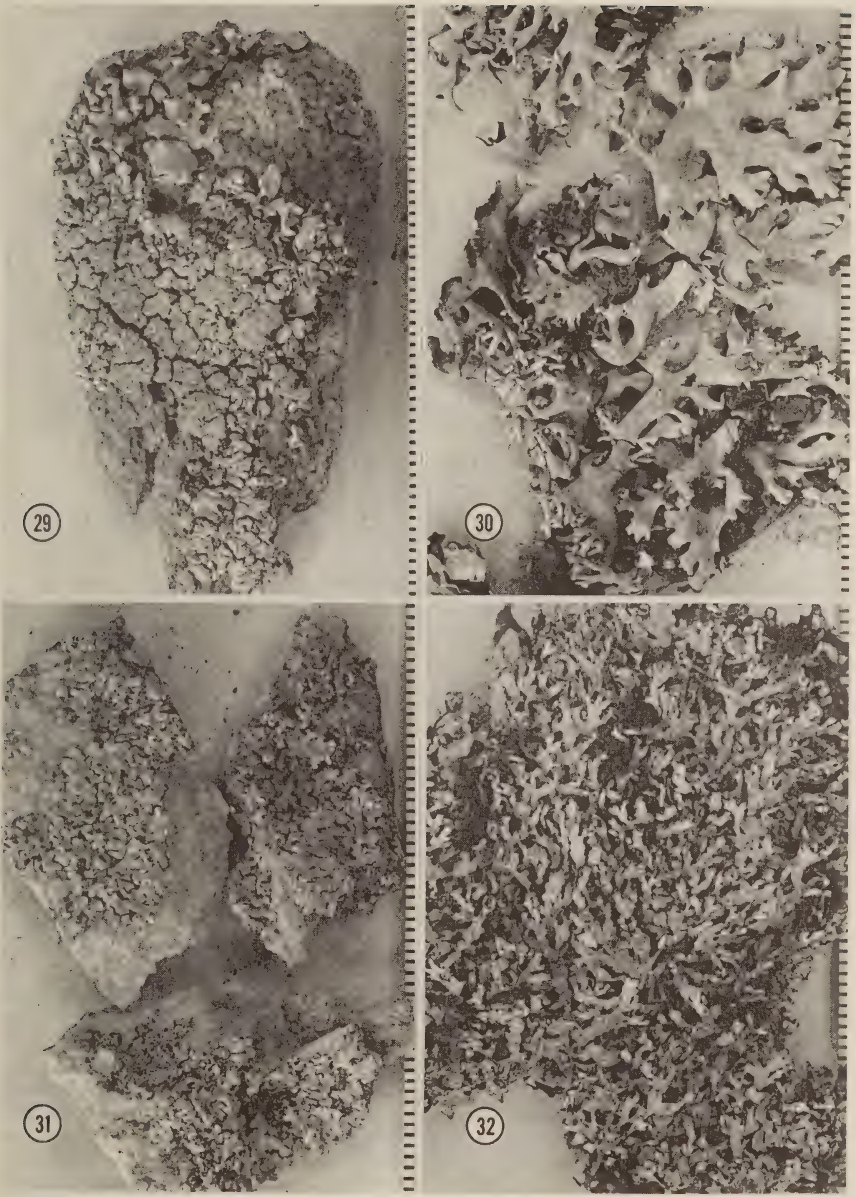
Xanthoparmelia pustulosorediata Hale, sp. nov. (Fig. 29)

Thallus adnatus, saxicola, fragilis, 5–8 cm latus, lobis subirregularibus, 1–3 mm latis, congestis, superne continuus vel albo-maculatus, rugosus, pustulatus, pustulis eruptentibus, sorediatis, subtus planus, modice rhizinosus.

Thallus adnate on rock, brittle and breaking apart when collected, 5–8 cm broad, dull yellowish green; lobes subirregular, 1–3 mm wide, short and crowded; upper surface continuous to faintly maculate in part, shiny to dull pruinose, soon strongly rugose and developing coarsely sorediate, erupting pustules covering much of the thallus; lower surface plane, pale brown or darkening, moderately rhizinate, the rhizines brown, simple, 0.2–0.8 mm long. Pycnidia and apothecia lacking.

Chemistry: stictic, constictic, and usnic acids, lusitana unknown.

Type collection: On crumbling sheltered granite in large koppie, 5 km NE of Aus on hwy 35 (road to Helmeringshausen), 4.7 km N of Hwy B4, elevation 1300 m, South West Africa/Namibia, Grid 2616 CB, *Hale* 81134, 27 April 1988 (US, holotype; LD, PRE, isotypes).



Figures 29 – 32. Species of *Xanthoparmelia*: 29, *X. pustulosorediata* (*Hale* 81134, holotype); 30, *X. salamphixantha* (*Hale* 79962, holotype); 31, *X. saleruptens* (*Hale* 79905, holotype); 32, *X. salkiboensis* (*Santesson* 21163, holotype). Scale in mm.

Additional specimens examined. South Africa. Cape Province: 3 km SW of Rooifontein on road to Gamoep, Grid 3018 AB, *Hale* 79710 (US). S.W.A./Namibia: Same locality as the holotype, *Hale* 81141 (US).

Dense pustulate-sorediate outgrowths characterize this unusual species, collected in extremely arid sites at the base of granite ledges where water accumulates during infrequent rains.

Xanthoparmelia salamphixantha Hale, sp. nov. (Fig. 30)

Thallus laxe adnatus, terricola, 4–8 cm latis, lobis sublinearibus, 2–5 mm latis, separatis, superne albo-maculatus, isidiis sorediisque destitutus, subtus canaliculatus, flavo-marginatus, nigricans, sparse rhizinosus.

Thallus loosely adnate to nearly free growing on soil and mosses, easily breaking apart, 4–8 cm broad, light yellowish green; lobes sublinear, 2–5 mm wide, dichotomously branched, more or less separate; upper surface uniformly white maculate, shiny, rugose and irregularly cracked with age, isidia and soredia lacking; lower surface weakly canaliculate with a raised yellow rim, pale brown or darkening and in part jet black, shiny, sparsely rhizinate, the rhizines dark brown, simple, 0.5–2 mm long. Pycnidia common; conidia 0.5 × 4–6 μm long. Apothecia substipitate, 3–5 mm in diameter; spores 5–6 × 9–10 μm.

Chemistry: salazinic (major), consalazinic, norstictic, and usnic acids, chalybaeizans unknown.

Type collection: On sterile soil in karoo pasture, on Hwy R364, 29 km S of junction with Hwy R27, elev. 600 m, Cape Province, South Africa, Grid 3119 CD, *Hale* 79962, 24 March 1988 (US, holotype; LD, PRE, isotypes).

Additional specimens examined. South Africa. Cape Province: Same locality as the holotype, *Hale* 79953 (US); near Boesmanskloof River (W of Piketberg), Grid 3218 DC, *Leighton* 149 (BOL, US).

While superficially similar to *X. amphixanthoides* (Stein. & Zahlbr.) Hale, *X. salamphixantha* has broad lobes with a heavily maculate surface, lacks terete laciniae, and darkens below.

Xanthoparmelia saleruptens Hale, sp. nov. (Fig. 31)

Thallus arcte adnatus, saxicola, fragilis, 1–3 cm latus, lobis subirregularibus, 0.8–1.5 mm latis, superne continuus, emaculatus, pruinosus, sparse pustulato-isidiatus, esorediatus, subtus planus, pallide brunneus, sparse rhizinosus.

Thallus tightly adnate on rock, fragile, 1–3 cm broad, light yellowish green; lobes subirregular, 0.8–1.5 mm wide, contiguous to subimbricate; upper surface continuous, dull white pruinose, sparsely pustulate-isidiate, the isidia irregularly developed from ridges, not becoming sorediate; lower surface plane, pale brown, sparsely rhizinate, the rhizines pale brown, simple, 0.1–0.3 mm long. Pycnidia and apothecia lacking.

Chemistry: salazinic, connorstictic, and usnic acids, chalybaeizans unknown.

Type collection: On large overhanging Table Mountain sandstone ledges, 7 km W of Oliewenboskraal on road to Paleisheuwel (west of Hwy N7), elev. 900 m, Cape Province, South Africa, Grid 3218 BD, *Hale* 79905, 25 March 1988 (US, holotype; PRE, isotype).

This is a rare member of the *X. eruptens* Hale group, also growing on the underside of large overhanging ledges.

Xanthoparmelia salkiboensis Hale, sp. nov. (Fig. 32)

Thallus laxe adnatus, saxicola vel muscicola, pulvinatus, fragilis, 4–8 cm latus, lobis sublinearibus, 0.8–2 mm latis, superne continuus, emaculatus, sorediis isidiisque destitutus, subtus planus, niger, sparse rhizinosus.

Thallus loosely adnate on rock or mosses over rocks, pulvinate, rather brittle, 4–8 cm broad, dark yellowish green; lobes sublinear, 0.8–2 mm wide, dichotomously branched, black rimmed, imbricate, irregularly laciniate with age; upper surface continuous, shiny, rugulose and transversely cracked with age, soredia and isidia lacking; lower surface plane, black, shiny, smooth to slightly rugulose, sparsely to moderately rhizinate, the rhizines black, rather coarse and unbranched, 0.3–0.5 mm long. Pycnidia common; conidia bifusiform, 0.5 × 4–5 μm. Apothecia not commonly developed, substipitate, 3–5 mm wide, the rim inrolled; spores 5–6 × 9–10 μm.

Chemistry: salazinic, consalazinic, norstictic (tr.), and usnic acids.

Type collection: Near Johnsell Point, Shira Plateau, Mt. Kilimanjaro, Tanzania, elev. 3950 m, *Santesson* 21163, 13 Jan. 1970 (UPS, holotype; US, isotype).

Additional specimens examined: Kenya: Sirimon Track, Mt. Kenya National Park, Kenya, *Moberg* 3948 (UPS); Wandare's Track, Aberdare National Park, Rift Valley/Central Province, Kenya, *Moberg* 4321 (UPS). Tanzania: Same locality as the holotype, *Santesson* 21177 (UPS); Peters Hut, Mt. Kilimanjaro, *Hedberg* 1395, *Santesson* 21163 (UPS); Koitobboss, Mt. Elgon, *Holm* 17:6 (UPS).

This high-elevation, black-rimmed lichen appears to be common at an elevation of 3600–4000 m in Kenya and Tanzania. It differs from *X. kiboensis* (Dodge) Krog & Swinsc. in the sublinear lobes, pulvinate growth habit, shiny lower surface, and chemistry (a dull rugose lower surface and norstictic and connorstictic acids in *X. kiboensis*).

Xanthoparmelia springbokensis Hale, sp. nov. (Fig. 33)

Thallus laxe adnatus, saxicola, 5–8 cm latus, lobis subirregularibus, 1.5–3 mm latis, superne continuus vel albo-maculatus, aetate valde rugosus, sorediis isidiisque destitutus, subtus planus, brunneus, modice rhizinosus.

Thallus adnate on rock, 5–8 cm broad, dull olive green; lobes subirregular, 1.5–3 mm wide, short and irregularly branched, more or less suberect at the tips, imbricate; upper surface continuous to distinctly white maculate, shiny, transversely cracked and strongly rugulose with age; medulla often pale yellow, the lower part ochraceous in patches; lower surface plane, pale brown, but often darkening at the tips, moderately rhizinate, the rhizines pale brown, 0.3–0.5 mm long, unbranched. Pycnidia common; conidia bifusiform, 0.5 X 5–6 μm. Apothecia well developed, substipitate, 2-5 mm in diameter; spores poorly developed, 5 X 9 μm.

Chemistry: salazinic (major), consalazinic, norstictic (minor), protocetraric (trace), and usnic acids, chalybaeizans unknown and skyrin (det. J. Elix).

Type collection: Sloping granite domes in karoo, 1 km E of Springbok, N side of Hwy R64, elev. 1100 m, Cape Province, South Africa, Grid 2917 DB, *Hale* 72249, 27 Jan. 1986 (US, holotype; PRE, isotype).

Additional specimens examined. South Africa. Cape Province: Same locality as the holotype, *Hale* 72251; Anenouspas, Grid 2917 BA, *Hale* 73232 (US); 1 km S of Nuwerus, Grid 3118 AB, *Hale* 72250 (US).

Confined to upper Namaqualand, *X. springbokensis* differs from closely related *X. neosynestia* in more irregular, adnate lobes, distinctive darkish green color, strong rugosity, and presence of skyrin. It often grows near the base of large sheltered rocks.

Xanthoparmelia subamplexuloides Hale, sp. nov. (Fig. 34)

Thallus arcte adnatus, fragilis, 4–7 cm latus, lobis subirregularibus, 0.5–1.5 mm latis, superne continuus, emaculatus, sparse vel modice isidiatus, isidiis subcylindricis, subtus planus, pallide brunneus, sparse rhizinosus.

Thallus very tightly adnate to tightly adnate on rock, fragile, 4–7 cm broad, yellowish green; lobes subirregular, 0.4–1.3 mm wide, short and irregularly branched; upper surface continuous, shiny, subrugose and transversely cracked with age, sparsely to moderately isidiate, the isidia mostly basally constricted and globose to subcylindrical, easily breaking off but not erumpent, 0.06–0.08 mm in diameter, to 0.5 mm high, the tips pale, weakly epicorticate, unbranched; lower surface pale brown, sparsely rhizinate, the rhizines pale brown, simple, 0.1–0.3 mm long. Pycnidia and apothecia lacking.

Chemistry: norlobaridone, unknowns, and usnic acid.

Type collection: on sheltered schistose sandstone, 51 km S of Windhoek on west side of Hwy 1/5 (opposite entrance to Bergland), elev. 1700 m, South West Africa/Namibia, Grid 2217 CC, *Hale* 81144, 26 April 1988 (US, holotype; LD, PRE, isotypes).

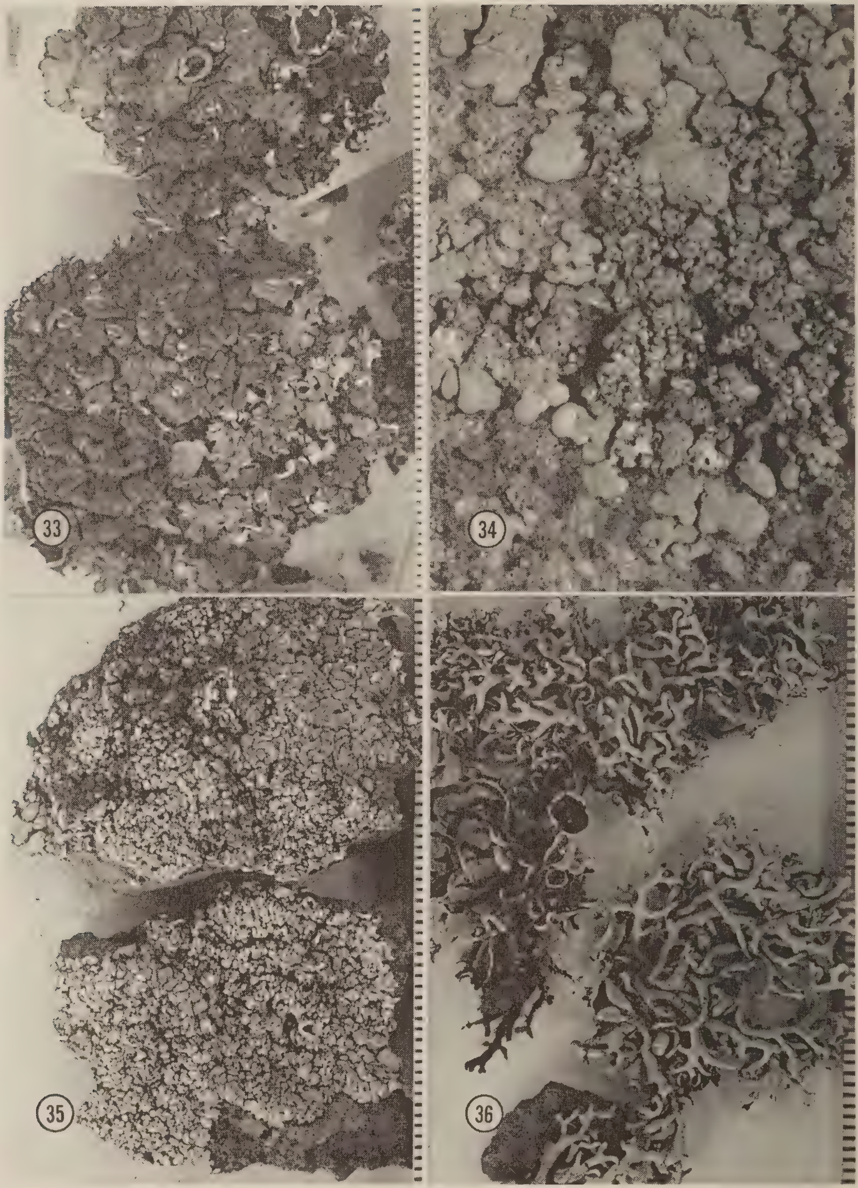
Additional specimens examined. S.W.A./Namibia: 47 km W of Windhoek (Khomas Highlands), Grid 2216 DA, *Hale* 81000, 81002 (US); 1 km E Neu Heusis (Khomas Highlands W of Windhoek), Grid 2216 DA, *Hale* 80956, 80957, 80959, 80961 (US); Hoogland, Waterberg Plateau National Park (NE of Otjiwarongo), Grid 2017 CA, *Hale* 80927 (US).

Near *X. amplexuloides* Hale (above), this Namibian species has much smaller lobes and isidia. It can be considered a tightly adnate morphotype.

Xanthoparmelia subbullata Hale, sp. nov. (Fig. 35)

Thallus adnatus, saxicola, 5–7 cm latus, lobis subirregularibus, 1.5–2 mm latis, superne continuus, emaculatus, dense bullato-rugoso-isidiato, isidiis fragilibus, subtus planus, modice rhizinosus.

Thallus adnate on rock, 5–7 cm broad, light yellowish green; lobes sublinear, 1–2 mm wide, rather short and irregularly branched, contiguous to crowded at the center; upper surface continuous, shiny, rugose and densely bullate-isidiate with age, the isidia fragile, 0.2–0.3 mm in



Figures 33–36. Species of *Xanthoparmelia*: 33, *X. springbokensis* (*Hale* 72249, holotype); 34, *X. subamplexuloides* (*Hale* 81144, holotype (×10)); 35, *X. subbullata* (*Hale* 77072, holotype); 36, *X. subconvoluta* (*Hale* 74455, holotype). Scale in mm.

diameter, sometimes breaking open but not sorediate; lower surface plane, brown, moderately rhizinate, the rhizines brown, simple, 0.5–1 mm long.
Pycnidia numerous; conidia bifusiform, 0.5 × 5–6 μm. Apothecia adnate, 1–2 mm in diameter; spores not developed.

Chemistry: salazinic, consalazinic, connorstictic, and usnic acids, chalybaeizans unknown.

Type collection: On doleritic outcrops along road, 8.5 km W of junction Hwy R396 and Hwy R393 near Moshesh's Ford, elev. 1900 m, Cape Province, South Africa, Grid 3027 DD, *Hale* 77072, 10 Oct. 1986 (US, holotype; PRE, isotype).

Additional specimens examined. S. Africa. Cape Province: Same locality as the holotype, *Hale* 77075 (US). Lesotho: 9 km W of Mpiti (N of Qachas Nek), Grid 3028 BA, *Hale* 81289, 81293 (US).

This species is obviously related to the widespread *X. chalybaeizans* (Stein. & Zahlbr.) Hale but is differentiated by the abundant production of coarse bullate isidia.

Xanthoparmelia subconvoluta Hale, sp. nov. (Fig. 36)

Thallus laxe adnatus, saxicola vel terricola, coriaceus, 6–8 cm latus, lobis sublinearibus, 0.7–2 mm latis, elongatis, superne continuus, emaculatus, sorediis isidiisque destitutus, subtus convolutus, brunneus, modice rhizinosus

Thallus loosely adnate on pebbles, rarely in part free growing on adjacent soil, rather leathery, 6–8 cm broad, light yellowish green; lobes sublinear, 0.7–2 mm wide, elongate and little branched, separate to imbricate; upper surface continuous, shiny, rugulose with age, soredia and isidia lacking; lower surface weakly to strongly convoluted but not rolled up, brown, moderately to densely rhizinate, the rhizines comparatively long and protruding from below, dark brown, unbranched, 0.5–1 mm long. Pycnidia common; conidia weakly bifusiform, 0.5 × 5–6 μm. Apothecia well developed, substipitate, 1–2 mm in diameter with inrolled rim; spores 5–6 × 9–10 μm.

Chemistry: salazinic, consalazinic, and usnic acid.

Type collection: Flat dolerite ridge in pasture, 6.8 km S of Sutherland on Hwy R354, elev. 1500 m, Cape Province, South Africa, Grid 3220 BC, *Hale* 74455, 29 Jan. 1986 (US, holotype; ANUC, PRE, isotypes).

Additional specimens examined. South Africa. Cape Province: Same locality as the holotype, *Hale* 74457, 74458 (US); Seweweekspoort, Grid 3321 AD, *Hale* 73426, 73435 (US); 15.9 km NE of Barrydale, Grid 3321 DD, *Hale* 74456 (US); 3.6 km N Hwy R62 on Kruisrivier road, Grid 3321 BB, *Hale* 73512 (US); Uniondalespoort, Grid 3323 CA, *Hale* 73442 (US); 42 km SSW of Nuwerus on Hwy R363, Grid 3118 AD, *Hale* 78845 (US).

More or less related to the vagrant *X. chlorochroa* group, *X. subconvoluta* is loosely attached to pebbles and is not so strongly convoluted as to hide the dense, protruding mass of rhizines below. It is also close to *X. amphixanthoides* (Stein. & Zahlbr.) Hale, which has terete secondary laciniae. From North America, *X. wyomingica* has shorter, more congested lobes and is not as dark below.

Xanthoparmelia subluminosa Hale, sp. nov. (Fig. 37)

Thallus laxe adnatus, coriaceus, 5–8 cm latus, lobis subirregularibus, 2–4 mm latis, superne continuus, emaculatus, dense isidiatus, isidiis cylindricis, medulla pro parte ochracea, subtus planus, niger, sparse rhizinosus.

Thallus adnate to loosely adnate on rock, firm but easily breaking apart, 5–8 cm broad, light yellowish green; lobes subirregular, 2–4 mm wide, irregularly branched, dark brown rimmed, imbricate; upper surface continuous, shiny, densely isidiate, the isidia cylindrical, 0.15–0.2 mm in diameter, to 1 mm high, black tipped, simple to coralloid branched; lower medulla in part dull reddish orange; lower surface plane, black, shiny, sparsely rhizinate, the rhizines black, coarse, unbranched, 0.4–0.8 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 μm. Apothecia lacking.

Chemistry: salazinic, consalazinic (minor), norstictic (tr.), protocetraric (tr.), and usnic acids, skyrin and a second unidentified anthraquinone (det. J. A. Elix).

Type collection: Coppins Crossing, elev. 600 m, Canberra, A.C.T., Australia. *Hale* 58524, 8 Jan. 1982 (US, holotype; CBG, isotype).

This is very close to *X. luminosa* (Elix) Elix & Johnst., another skyrin-containing Australian lichen which lacks isidia.

Xanthoparmelia submougeotii Hale, sp. nov. (Fig. 38)

Thallus adnatus, saxicola, 3–4 cm latus, lobis sublinearibus, 0.6–1.2 mm latis, imbricatis, superne continuus, emaculatus, sorediatus, soraliis subterminalibus, capitatis, subtus niger, modice rhizinosus.

Thallus adnate on rock, rather brittle and subpulvinate, 3–4 cm broad, dull yellowish green; lobes sublinear, 0.6–1.2 mm wide, rather short and irregularly dichotomously branched, brown rimmed, imbricate; upper surface continuous, shiny, sorediate, the soralia subterminal, capitate, 0.5–1 mm in diameter; lower surface plane, dark brown at the tips but black at the center, shiny, rugulose, moderately rhizinate, the rhizines black, simple, 0.2–0.4 mm long. Pycnidia and apothecia lacking.

Chemistry: stictic, constictic, norstictic, and usnic acids.

Type collection: Cordon Barril, Masafuera, Juan Fernandez, *C. & I. Skottsberg* 90, 1 March 1917 (NY, holotype; US, isotype).

This rare sorediate species is related to *X. mougeotii* (Schaer.) Hale, a well-known much smaller, very tightly adnate lichen. The only other sorediate *Xanthoparmelia* with a black lower surface is *X. microspora* (Müll. Arg.) Hale, which contains salazinic acid.

Xanthoparmelia substenophylloides Hale, sp. nov. (Fig. 39)

Thallus arcte adnatus, saxicola, 2–6 cm latus, lobis sublinearibus, 0.3–0.6 mm latis, laciniatis, superne continuus, emaculatus, modice isidiatus, isidiis cylindricis, subtus planus, niger, modice rhizinosus.

Thallus tightly adnate on rock, 2–6 cm broad, light yellowish green but darkening at the center; lobes sublinear, 0.3–0.6 mm wide, elongate, dichotomously branched, separate to contiguous, laciniate marginally with age, the laciniae dichotomously branched, 0.2–0.4 mm wide; upper surface continuous, shiny, moderately isidiate, the isidia cylindrical, 0.06–0.13 mm in diameter, 0.1–0.3 mm high, the tips epicorticate, mostly pale, unbranched to sparingly branched; lower surface plane, dark brown at the tips but blackening at the center, shiny, moderately rhizinate, the rhizines black, simple, 0.1–0.2 mm long. Pycnidia rarely developed; conidia bifusiform, 0.5 × 5–6 μm. Apothecia lacking.

Chemistry: Stictic, constictic, norstictic and usnic acids.

Type collection: Sandstone ledges, about 5 km E of Holy Forest (NW of Thohoyandou, elev. 1000 m., Venda, South Africa, Grid 2230 CD, *Hale* 79148, 14 Nov. 1986 (US, holotype).

Additional specimens examined. South Africa. Cape Province: 28.2 km W of Mosselbaai, Grid 3421 BB, *Hale* 73844 (US); Venda: 2 km E of Holy Forest, Grid 2230 CD, *Hale* 79149 (US); Transkei: Moordenaarsnek on R56, Grid 3028 DC, *Hale* 76913 (US). Brazil: Rio de Janeiro, *Glaziou* s.n. (US). Venezuela: Mucuy, Estado Mérida, *Hale* 43039a (US).

This species is characterized by the narrow, relatively elongate, contiguous, little branched lobes and delicate pale-tipped isidia. Another South African species, *X. pseudocongensis* Hale, is close but has shorter, black-rimmed, crowded lobes and black-tipped isidia. The Australasian *X. mougeotina* (Nyl.) Galloway has smaller, subglobose, black-tipped isidia.

Xanthoparmelia tsekensis Hale, sp. nov. (Fig. 40)

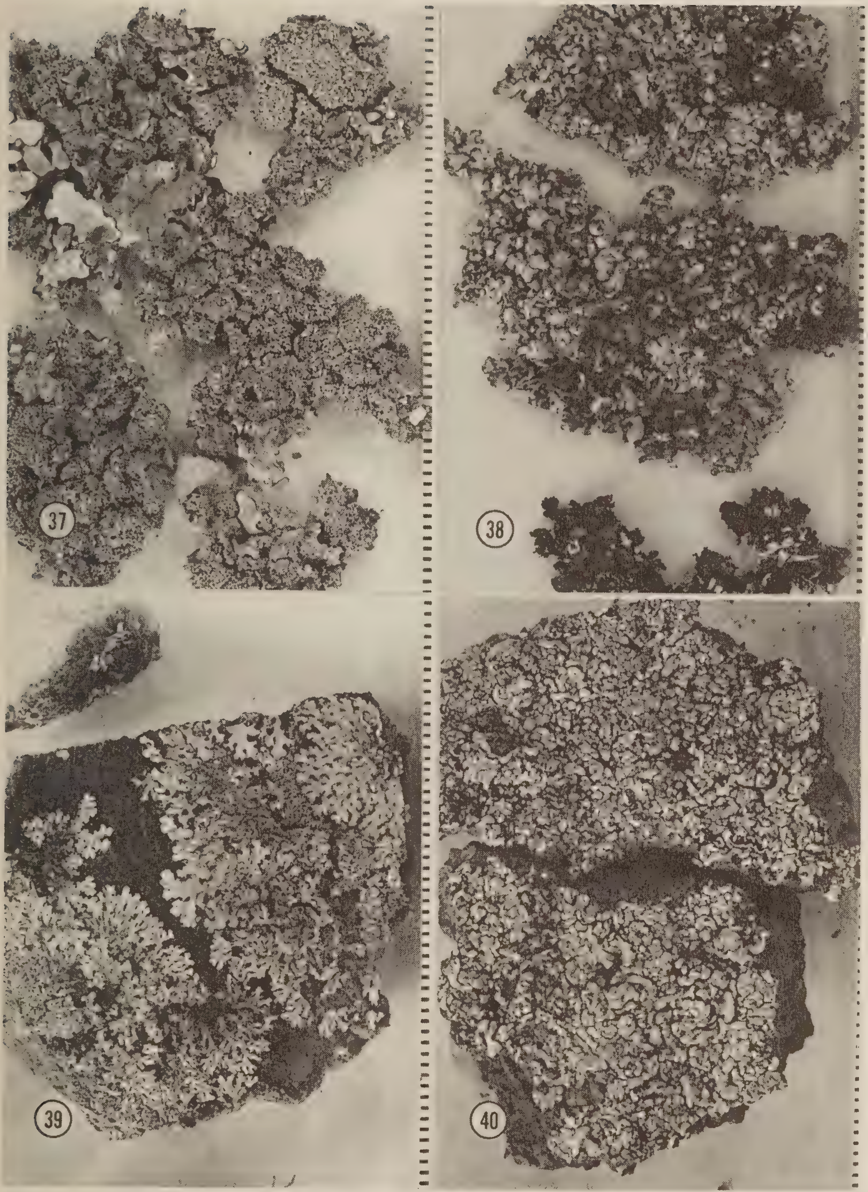
Thallus arcte adnatus, saxicola, coriaceus, 6–8 cm latus, lobis sublinearibus, 0.6–1 mm latis, sublaciniatis, superne continuus, emaculatus, isidiis sorediisque destitutus, medulla pro parte ochracea, subtus planus, brunneus, modice rhizinosus.

Thallus tightly adnate on rock, leathery, 6–8 cm broad, darkish yellow green; lobes sublinear, 0.6–1 mm wide, irregularly branched, short and crowded, sublaciniate, the laciniae in part subascending, black rimmed; upper surface continuous, shiny, bullate and transversely cracked with age, isidia and soredia lacking; lower medulla in part ochre; lower surface plane, brown, moderately rhizinate, the rhizines brown, simple, 0.2–0.3 mm long. Pycnidia common; conidia bifusiform, 0.5 × 5–6 μm. Apothecia lacking.

Chemistry: stenosporonic, colensoic, salazinic, norstictic, and usnic acids, 2–3 unidentified anthraquinones.

Type collection: On crumbling dolerite boulder along river, 5.2 km NW of Thaba Tseka junction on Moteng Pass-Sani Pass road, elev. ca 2900 m, Lesotho, Grid 2928 BD, *Hale* 81451, 7 May 1988 (US, holotype; LD, PRE, isotypes).

This species, externally similar to *X. conjuncta* Hale (descibed above) represents a new combination of acids for the nonisidiate group with a pale lower surface. Another Drakensberg endemic, *X. naudesnekia* Hale, also has stenosporonic acid as the major metabolite but along with the hypostictic acid series, as well as broader lobes, to 1.5 mm wide. Other South African species with stenosporonic acid (nonisidiate *X. shebaiensis* Nash & Elix and *X. stenosporonica* Hale



Figures 37 – 40. Species of *Xanthoparmelia*: 37, *X. subluminosa* (*Hale* 58524, holotype); 38, *X. submougeotii* (*Skottsberg* 90, holotype); 39, *X. substenophylloides* (*Hale* 79148, holotype); 40, *X. tsekensis* (*Hale* 81451, holotype). Scale in mm.

and isidiate *X. keralensis* Hale) are very tightly adnate and black below.

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SUGIYAMAEMYCES, A NEW GENUS OF LABOULBENIALES (ASCOMYCETES) ON CLIDICUS (SCYDMAENIDAE)

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SUMMARY

The genus Sugiyamaemyces is established for a taxon on Clidicus (Coleoptera, Scydmaenidae), in which the receptacular cells directly subtending the appendage and perithecium are laterally adnate, the perithecium arises from the third, rather than the second cell of the receptacle, and an extensively branched appendage is frequently present. The species S. orousettii is described.

In many genera of the Laboulbeniales the exact point of origin of the perithecium is uncertain because of a lack of sufficiently immature material. Usually, the source has been judged to be the cell directly underlying the perithecial stalk cell at maturity. Except in the highly modified genus Coreomyces (Thaxter, 1908) and rarely in Herpomyces (see Tavares, 1966), the perithecium in the Laboulbeniales arises as a lateral branch of one of the receptacular cells. This cell has generally been identified as cell II (the second cell of the typically 3-celled lower spore segment) or as a secondary derivative of cell II. In Amorphomyces (Tavares, 1970) and Rhizopodomyces (Benjamin, 1979), a septum does not separate two upper cells in the lower spore segment, so that the perithecium is an outgrowth of the upper cell of a two-celled receptacle. In most genera of the Dimorphomyceteae and apparently also in Nanomyces, perithecia are produced by outgrowths of the foot cell I (Tavares, 1985).

Thalli recently found by J. Orousset on Clidicus formicarius Pascoe (Coleoptera, Scydmaenidae, Clidicini) differ from previously described genera of the Laboulbeniales by the production of a series of lateral appendages from the superposed cells of the primary appendage and by the presence of laterally adnate III and VI cells (the receptacular cells subtending the appendage and perithecium). Adnate III and VI cells are a conspicuous characteristic of Stigmatomyces and their presence in the fungi on Clidicus suggests a relationship, particularly because the appendage cells sometimes bear phialides anteriorly (on the side toward the perithecium), rather than branches. Furthermore, there apparently are four outer wall cells in each vertical row in both genera--two tall lower cells and two very short upper cells. However, Stigmatomyces is restricted to Diptera and normally has an unbranched appendage.

In addition, the fungus on Clidicus differs from Stigmatomyces in the point of origin of the perithecium, as well as the degree of cell wall thickening of some perithecial cells. Consequently, this taxon is now being described as a new genus, in honor of Dr. Keiichi Sugiyama, Shizuoka University, Japan, who has been active, with his students, in investigating the Laboulbeniales of the southeast Asian area.

Sugiyamaemyces I. Tavares & Balazuc, gen. nov.

Receptaculum tribus cellulis confectum, quarum summa perithecii stirpem attingit. Appendicis superpositae cellulae ramos a latere sufferentes. Basalium perithecii cellularum atque perithecii stirpis cellulae parietes haud crassescentes.

Typus: Sugiyamaemyces oroussetii.

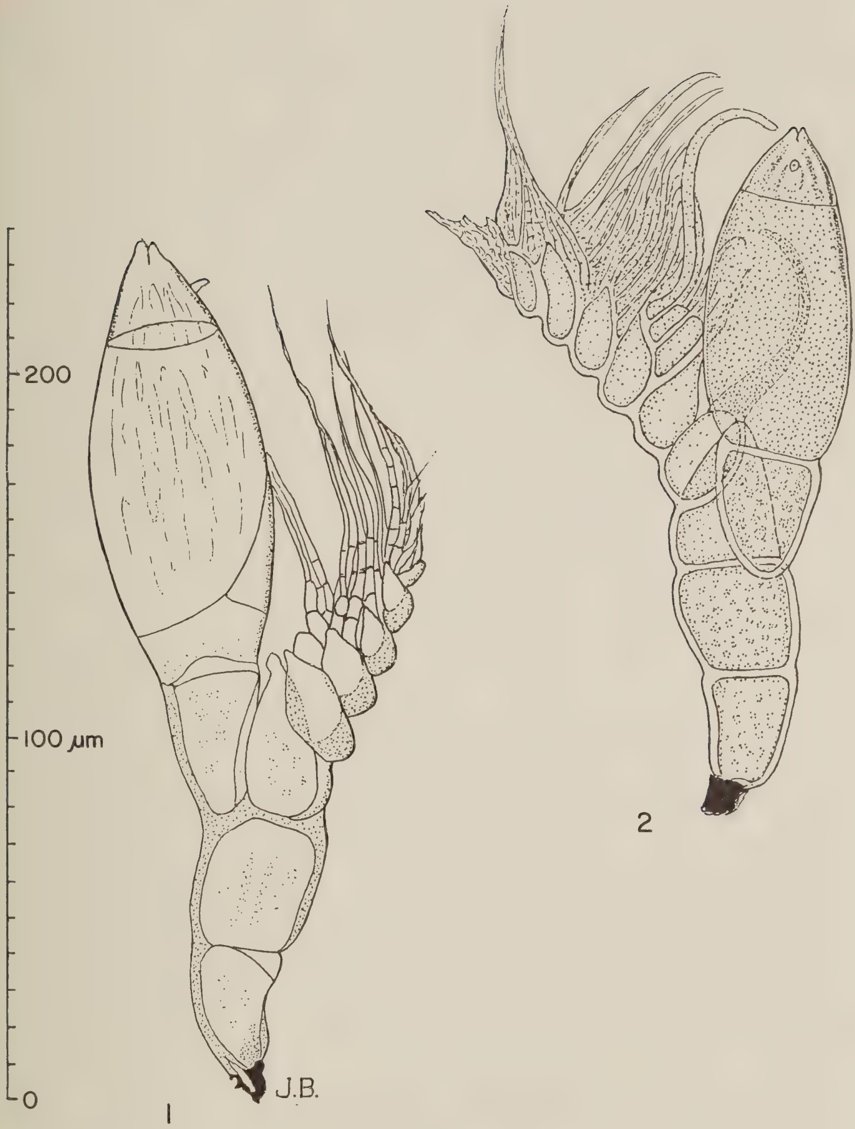
Basal and suprabasal cells of thallus superposed; upper cell of 3-celled receptacle laterally adnate to stalk cell of perithecium; appendage consisting of series of superposed cells, which produce lateral appendages. Walls of perithecial basal cells and walls of secondary stalk cells not thickening, so that these cells are not clearly visible and soon deteriorate.

Sugiyamaemyces oroussetii I. Tavares & Balazuc, sp. nov.

Receptaculi tres cellulae componentes perithecii stirpem longitudine subaequantes. Primi axis appendicis cellulae multo breviores, latae, a latere appendices proferentes, quae ipsae casu longos graciles ramos ferunt. Perithecium fusiforme, vel simplex, vel brevi (long. 1 um) prominentia ornatum.

Parasitus Clidici formicarii Pascoe (Coleoptera, Scydmaenidae, Clidicinae) in insula Borneo.

Thallus pale to deep brownish yellow; three superposed cells of receptacle approximately same height as perithecial stalk cell; cells of primary axis of appendage much shorter, broad, separated by diagonal septa, these cells extending anteriorly into lateral appendages; each lateral appendage may produce a series of long, slender, lateral branches. Perithecium somewhat fusiform, narrow

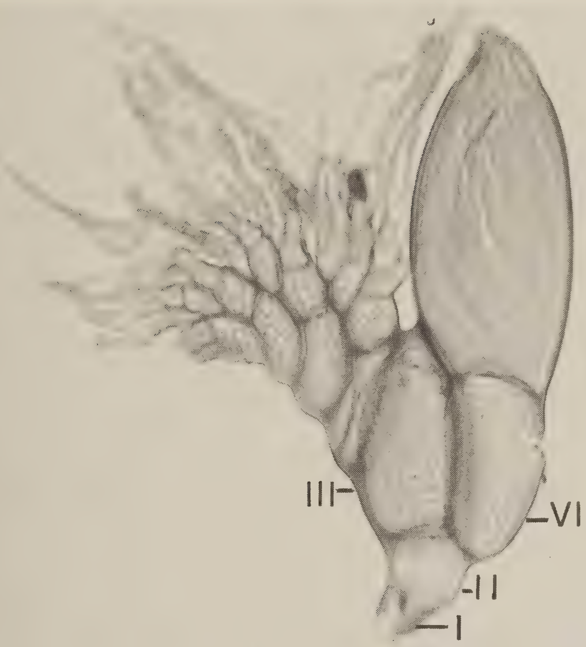


Figs. 1-2. *S. oroussetii* on *C. formicarius*, Borneo (ZMB). Drawings by J. Balazuc. 1. Holotype (UC). 2. Mature thallus with well-developed appendage system (Balazuc collection).

to broad, borne on stalk cell that is longer than wide and adnate to cell III of the receptacle; perithecium having no visible secondary stalk cell or basal cells. Perithecial apex simple or having extremely short outgrowth (ca. 1 um x 1 um) terminating one vertical row of outer wall cells. Trichogyne stump usually prominent. Size range: total length: 118-250 um; total length of perithecium above stalk cell (in thalli having 2-celled spores): (59)65-106(120) x (22)24-40(45) um; length of cell II: 15-37 um; width of cell II: 15-29 um. On Clidicus formicarius Pascoe, Borneo, Zoological Museum, Berlin, DDR (A. R. Wallace collection ?; see Pascoe, 1863) (UC) (figs. 1, 10).

The perithecial apices vary, but there is usually a short, thin, apical outgrowth from one cell row (figs. 5, 10). Often, there is also visible on sharply narrowed perithecial apices a shorter narrow outgrowth. Other perithecia have a simple, more evenly rounded apex. The side of the perithecium just below the apex generally is convex on the side opposite the trichogyne stump, which is on a plane or slightly concave surface. The trichogyne stump (figs. 1, 8, 10) is usually 1/2-2/3 the distance between the base of the third tier of outer wall cells and the perithecial apex, but it is sometimes closer to the apex or not visible at all. Although the perithecia appear to have four outer wall cells in each vertical row, septa between these cells are difficult to see. The two lower cells in each row are extremely tall, with lower septa in all rows presumably at the same levels (second septum shown in figs. 1, 2). There seems to be variation, however, in the height of the subapical and apical cells in each row. The upper septa of the third tier of outer wall cells, when they are visible at all, do not seem to lie at the same level in all four vertical rows. The visible septa sometimes are midway between the upper end of the second tier of cells and the perithecial apex. At other times, the third or subapical cells are quite short. In the primary appendages, the lower cells become widened and secondary lateral branches grow toward the perithecium (figs. 3, 4). There are usually about four wide cells in the secondary branches, which produce narrow, thin tertiary branches extending upward. At first, there is a tall I cell, and a slightly shorter II cell, with the perithecial primordium rising from near the base of the

Figs. 3-5. Sugiyamaemyces oroussetii on Clidicus formicarius. 3. Mature thallus with extensively branched appendage, proportionally longer III and VI cells (foot broken off). Orousset collection (male). Borneo (ZMB). X 450. 4-5. Orousset collection (type of host, male). Sarawak (BMNH). X 450. 4. Small thallus having few spores (length indicated by lines), well-developed appendage. 5. Larger thallus having thicker cell walls; note slender, short, apical protuberance on perithecium (arrow).



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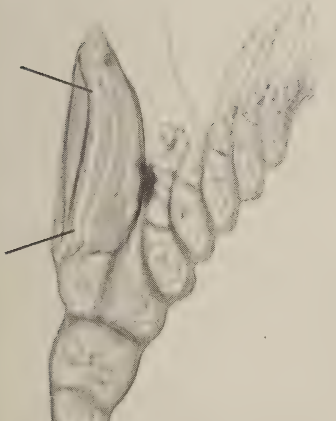

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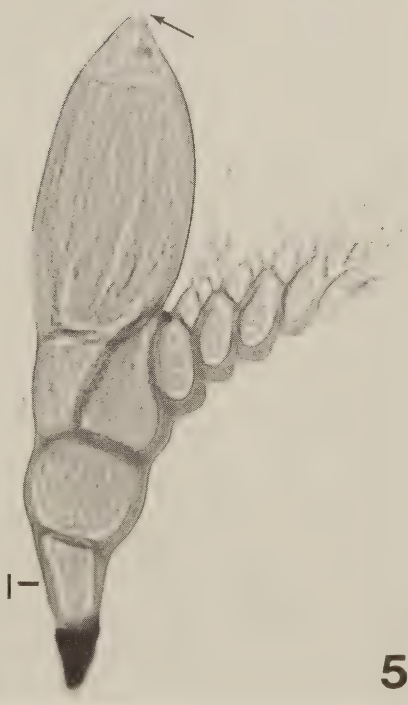

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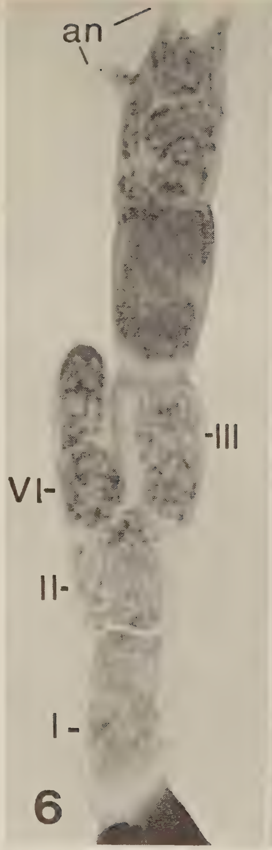
III cell (fig. 7, right). At this time, there is a short row of sessile phialides on an unbranched appendage. It is from the position of these phialides that the secondary branches arise. In some mature thalli, the primary appendage axis remains narrow and any lateral outgrowths are broken off.

Two males of Clidicus formicarius were found to be infected. On one from Borneo (Zoological Museum, East Berlin, DDR), thalli were found on the profemurs, protibias, and brushes of the apex of the mesotibias. On the type of C. formicarius from Sarawak (British Museum of Natural History), thalli were found on the profemurs and mesotibias. Clidicus is typically an Indomalayan genus. Species seem to be rare in nature and are infrequently represented in museum collections. They live in forest humus and their biology is not well known. The hosts of Sugiyamaemyces oroussetii may be termitophiles or myrmecophiles, which could account for their scarcity in museum collections.

There are two quite different forms of thalli among the specimens observed. One has a broad perithecium and heavily thickened walls on lower appendage and upper receptacle cells; in this form, there is a tendency for the appendage to diverge at a strong angle. In the other form, the perithecium is quite slender and the appendage and receptacle tend to be curved in an arc; the cell walls are not strongly thickened. The exact position on the host of thalli of the two forms was not noted; it is probable that the form of the thallus is related to position of growth and that thickness of the lower appendage

Fig. 6. Stigmatomyces on Anastrepha striata Schiner, Guacimo, Province of Limon, Costa Rica, April 8, 1987, comm. I. Hedstrom. Beginning of perithecial development from suprabasal cell. Lactophenol-cotton blue. X 670. Figs. 7-8. Sugiyamaemyces oroussetii on Clidicus formicarius. 7. Young thalli. At left, trichogyne stage, showing origin of perithecium from cell III--long, slender branches emerge from each of the superposed cells of the appendage. At right, two sporelings, both having perithecial outgrowths, cells I and II, and apparent antheridia (the top and bottom ones shown seem to come from the upper thallus with intact foot and the middle antheridium from the lower thallus). The long primary appendage of the upper thallus extends to the larger thallus at left. Orousset collection (from male). Borneo (ZMB). X 670. 8. Mature thallus showing origin of VI cell from cell III; II and the cell walls of the appendage axis have not broadened and II and VI have not become adnate. Appendage development is slight. Orousset collection, from type of host species (male), Sarawak (BMNH). X 450.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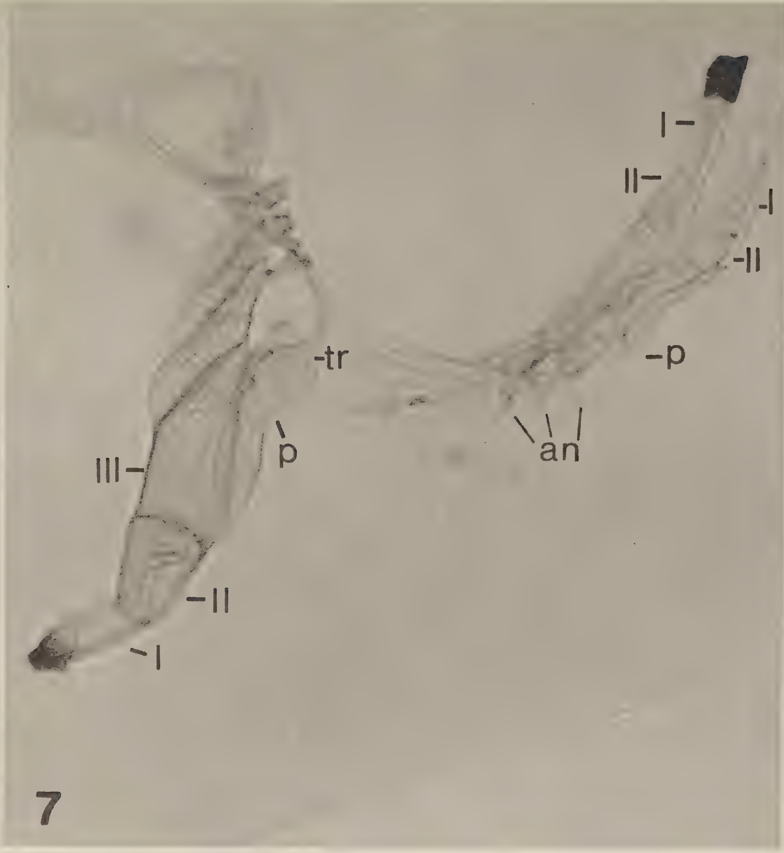
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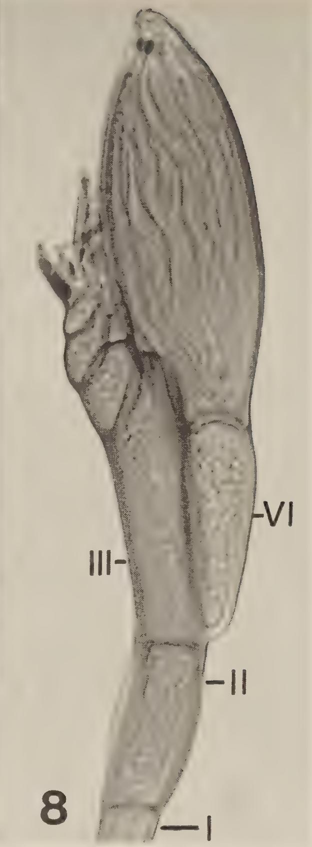

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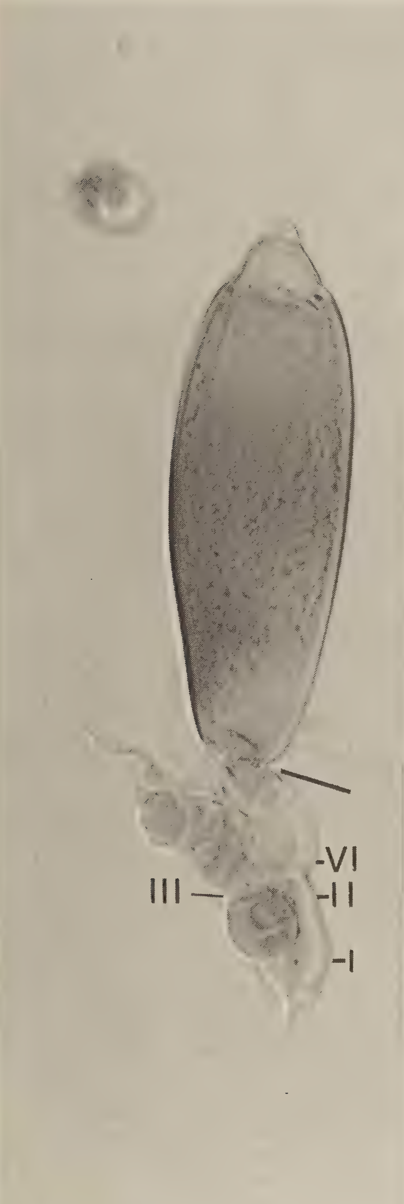
cell walls increases with age. There seem to be no distinct characters that would indicate that these two forms should be placed in different species. Both forms were found among specimens from Sarawak and those labelled Borneo.

In a well-developed appendage system, a secondary axis may form anteriorly (toward the perithecium) from each of the lower cells of the primary axis. Sometimes, cells may only produce phialides or a short row of unmodified cells that do not bear a series of anterior branchlets. Some of the sessile phialides of the young thallus probably grow out to form the regularly arranged branches. In the material labelled "Borneo," a well-developed secondary axis may resemble the first because the lower cells widen and become thick-walled. The Sarawak thalli had undergone no widening of the lower secondary axis cells. Each of the secondary axis cells may produce anteriorly a long, slender, hyaline, septate branchlet (fig. 5) that may sometimes be hooked at the end rather than straight. These slender branchlets also occur on the upper cells of the primary axis, generally at the end of a group of short, rounded cells (fig. 5). Thus, an appendage system can have a complex series of branches or it may be quite simple, usually because the long branches have broken off by maturity. The initial appendage, bearing lateral phialides (fig. 7), is reminiscent of that of Stigmatomyces. In addition, in young thalli on Clidicus, the perithecial primordia are attached near the base of cell III (figs. 7, 8), rather than at the upper end of cell II as in Stigmatomyces (fig. 6). In the Clidicus fungi, the attachment to the upper part of cell II occurs later as the cells enlarge, thus obscuring the true point of origin of the perithecium (figs. 3-5).

Furthermore, the secondary stalk cell (VII) and the basal cells of the perithecium have well-developed cell walls in Stigmatomyces that are clearly visible at maturity. In the taxon on Clidicus, the septa between the outer wall cells are difficult to see and the walls of the secondary stalk cell and perithecial basal cells are almost impossible to detect.

One specimen has been found by J. Orousset on the lectotype of Clidicus laticeps Pic (Shembaganur, Madura Province, India, MNHN, Paris) that appears to be a second species. However, the material is inadequate and description should await the discovery of more specimens. In this taxon, a narrow perithecial base forms a short stalk

Figs. 9-10. 9. Sugiyamaemyces sp. on Clidicus laticeps, India. Orousset collection. Lectotype of host species (MNHN, Paris). Line indicates narrow stalk at base of perithecium. X 560. 10. Sugiyamaemyces oroussetii on C. formicarius, Borneo (ZMB). Holotype (UC). Note apical outgrowth (arrow), trichogyne stump (line). X 560.



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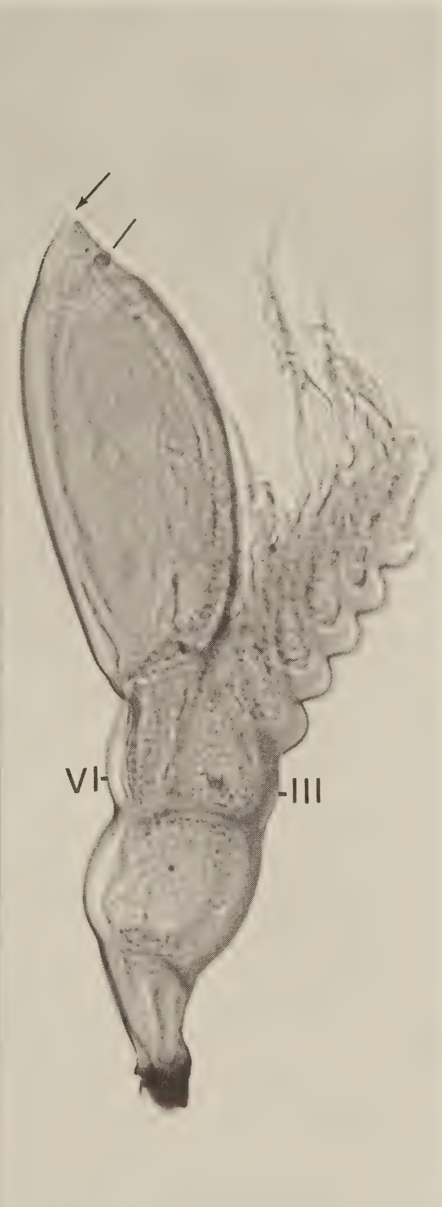

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rising from cell VI and the appendage is less well developed (fig. 9). The perithecium widens subapically just below what appears to be a slightly inflated subapical tier of outer wall cells.

DISCUSSION

In Sugiyamaemyces, there is an unusual manner of perithecial production. The appearance of the septum across the top of the third cell indicates that it is probably the original spore septum. The two lower cells of the receptacle are separated by a thinner cross-wall than that separating the second and third cells (figs. 5, 10). This suggests that the lowermost septum is produced last and that the first septum of the receptacle is that separating cell III from the initial lowermost cell. Thalli having well-developed perithecia give the appearance of a perithecium arising from the upper end of cell II, the suprabasal cell; however, in some thalli, it is clear that the perithecium actually arises from the side of the third receptacle cell (figs. 7, 8). Apparently, as the receptacle and perithecial stalk cell enlarge, the lower wall of the stalk cell and a portion of the upper wall of the suprabasal cell grow together, forming a common wall. It was not possible to detect a clear pore between VI (the perithecial stalk cell) and the third receptacle cell. However, the appearance of the wall and cytoplasm indicated that there is probably a central pore in the septum. One could regard the perithecium-producing cell as an undivided II-III cell and the second cell of the receptacle as a Ia cell, secondarily separated from the I cell. In Chitonomyces a Ia cell may be formed and division of II and III occurs late. In this unrelated genus, the wall cells of the perithecium are sometimes hard to distinguish as they are in Sugiyamaemyces (see Thaxter, 1924; Tavares, 1985).

In some other genera, absence of the appropriate stages may have led to a misinterpretation of the origin of the perithecium and the perithecium may, in fact, have arisen from the third, rather than the second, cell of the receptacle. The significance of the production of the perithecium by the cell just below the original spore septum rather than the cell just above the foot cell is not clear, but perithecial origin might be influenced by the position and identity of the first septum to be formed in the receptacle. In those genera that have been most thoroughly studied, cell II produces the perithecium, but a generalization about origins based on a few genera is certain to have exceptions when sufficient material is available for study.

In Sugiyamaemyces, the walls of the perithecial basal cells are thin and difficult to detect, as they are in Diplopodomyces on myriapods, Kruphaiomyces on Endomychidae (Coleoptera), Distolomyces on Dermaptera and genera in Dimorphomyceteae (having compound antheridia), Euphoriomyceteae (having specialized perithecial apices and simple phialides), and Drepanomyceteae in the Ceratomycetaceae (see Tavares, 1985, Thaxter, 1931). The presence of genera having poorly developed cell walls in the perithecium (often within a relatively thick enveloping wall) in several unrelated groups suggests that this character is a modification that occurs in more highly evolved genera and perhaps is associated with a reduction in thallus size or an adaptation to some conditions of the environment. When the thallus becomes more compact, it should become less susceptible to damage by contact with surrounding objects. The thickening of the outer wall of the base of the perithecium and the inclusion of perithecial basal cells and the secondary stalk cell within this protective wall would reduce the need for thick walls around each of these lower cells. The short, delicate stalk subtending the perithecium in the undescribed taxon of *Sugiyamaemyces* on *Clidicus laticeps* conceivably would reduce the ability of this taxon to withstand damage.

With the possible exception of *Acompsomyces stenichni* (Scheloske) I. Tavares (excluded by Benjamin [in press] from the genus) and a possible undescribed species of *Stemmatomyces*, *Sugiyamaemyces* does not appear to be closely related to other genera occurring on Scydmaenidae. *Diclonomyces* has a simple appendage system consisting of long branches arising basally. The perithecium of *Acrogynomyces* has a persistent terminal trichogyne base; the thallus has a simple appendage bearing a few phialides. A certain amount of variation occurs in appendage development in *Cryptandromyces*, which has clearly delimited subequal cells in the outer perithecial walls, rather than strongly unequal cells (see Tavares, 1985). The genera that have been reported previously on Scydmaenidae have a greater degree of thickening of the cell walls of the basal cells of the perithecium, as well as more readily visible perithecial wall cells.

The seriate primary axis cells in the appendage of *Sugiyamaemyces* bear a similarity to the unbranched seriate appendages of the undescribed *Stemmatomyces* on Scydmaenidae (Coleoptera) and of *Stigmatomyces* on Diptera. The arrangement of lateral branches produced by the primary axis cells in *Sugiyamaemyces* resembles the close, regular arrangement of primary axis cells and lateral branches in *Sphaleromyces lathrobii* Thaxt. and *Corethromyces cryptobii* Thaxt., both parasitizing Staphylinidae (Coleoptera) (see Tavares, 1985). In these two species, there are well-defined perithecial outer wall and basal cells.

At first glance, one is struck by the similarity of the receptacle of *Sugiyamaemyces* and that of *Stigmatomyces* because of the adnate III and VI cells. Evidence indicates that as in *Laboulbenia*, the VI cell of *Stigmatomyces* arises from cell II (fig. 6; see also Thaxter, 1896, pl. 1). Nevertheless, it is possible that *Sugiyamaemyces* and *Zeugandromyces*, for example (parasites of Staphylinidae originally placed in *Stigmatomyces*; see Thaxter, 1931), as well as *Stigmatomyces*, *Acompsomyces*, and *Stemmatomyces*, may have arisen from a common ancestor. Both Scydmaenidae and Staphylinidae belong to the Staphylinoidea. Perhaps *Sugiyamaemyces* is a highly evolved genus that has undergone modification of the lower part of the perithecium, elongation of the lower two cells in the vertical rows of perithecial outer wall cells, and elaboration of the appendage system. *Stigmatomyces* has also undergone elongation of the lower perithecial outer wall cells. The habits of its hosts may reduce the likelihood of damage to a slender, elongate thallus.

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INDEX TO J. B. ELLIS'S TYPES OF PYRENOMYCETES WITH AMYLOID ASCAL RINGS

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ABSTRACT

An index to the types of 202 species and infraspecific taxa now belonging to Amphisphaeriaceae, Diatrypaceae, and Xylariaceae that were described by J. B. Ellis is presented. The names listed here are based on specimens deposited in herbaria at NY, FH, BPI. A list of synonyms based on the literature is provided.

INTRODUCTION

Job Bicknell Ellis (1829-1905) was born in northern New York State, but lived most of his life in Newfield, New Jersey. Most of his collections were made in Newfield or the immediate vicinity. For several years he was a teacher of classics and also school principal. In 1855 he began his mycological work when he started corresponding with Henry William Ravenel, a well established mycologist from South Carolina. Ravenel encouraged Ellis's interest in fungi, introducing him to Systema Mycologicum (Fries, 1821-1832) and other mycological works. In addition, Ravenel advised Ellis to send undescribed species to European mycologists because of their older tradition in that field as well as their larger, world wide collections. He maintained a very close contact with mycologists from North America and Europe, such as M. J. Berkeley, M. C. Cooke, W. A. Kellerman, H. Rehm, F. de Thuemen, P. Sydow, P. A. Saccardo and others, who in many ways contributed to his knowledge of fungi (Kaye, 1986; Rogers, 1981).

Ellis had a great interest in parasitic ascomycetes, however, he described many fungi in other groups as well. He issued the following exsiccatae, with the support of W. G. Farlow (at Harvard University), and B. M. Everhart: FUNGI NOVA-CAESAREENSES (Fungi of New Jersey) Ellis, NORTH AMERICAN FUNGI Series I - Ellis, and Second Series - Ellis & Everhart, and FUNGI COLUMBIANI - Ellis & Ev. Everhart, a Philadelphia busisnessman, was a long-time associate of Ellis, and they published new species as "Ell. et Ev". Although at first an amateur, Ellis was able to build up his own scientific reputation, and is widely recognized for his pioneer work in mycology. In 1896, Ellis sold his Herbarium, types, and library to the New York Botanical Garden (NY), and as result of this, most of the holotypes are found at NY, as are sets of North American Fungi - Series I, and Second Series, and Fungi Columbiani. The Herbarium Mycologicum (Everhart's sets of Ell. & Ev. species), Fungi Nova-Caesareenses, and both Series of North American Fungi are deposited in the Farlow Herbarium (FH). The U. S. National Fungus Collection (BPI) has parts of both series of North American Fungi and Fungi Nova-Caesareenses. More detailed information about locations of the exsiccatae cited above are given by Stevenson (1971), and Stafleu and Cowan

(1976). The following genera were named after Ellis: *Ellisiella* Sacc. (1880), *Ellisiodothis* Theiss. (1914), *Ellisiellina* da Camara (1949), *Ellisiopsis* Bat. (1956), *Ellisia* Bat. & Peres (1965), and *Elletevera* Deighton (1969), the latter in honor of the Ellis & Everhart association.

In the present paper an index to the 202 taxa named by J. B. Ellis in genera that are today attributed to the families Amphisphaeriaceae, Diatrypaceae, and Xylariaceae is presented. These families are closely related to one another, and have as one of their most important features an ascal ring that stains blue with iodine (in Melzer's solution), readily distinguishing them from other families of Pyrenomycetes (although the ascal rings of many Diatrypaceae either do not become blue in iodine, or are so small, or the reaction so weak that it is essentially absent). According to Müller & Arx (1973) these families are placed within the order Sphaeriales, whereas Eriksson & Hawksworth (1987) place the Xylariaceae and Amphisphaeriaceae within the Xylariales, and the Diatrypaceae in its own order, Diatrypales.

Type specimens located in the herbarium of The New York Botanical Garden are considered to be holotypes, except those described by Cooke & Ellis. For those species, the material at NY is considered isotypic, and the holotype is supposedly at The Royal Botanic Garden, Kew (K). Type specimens located at FH, and BPI are considered isotypes. Some specimens issued in North American Fungi are isotypes, and these are so indicated in the index. Where more than one collection is cited in the protologue, all types are considered to be syntypes, unless a lectotype has been designated. No lectotypification are expressed or implied here. Information within brackets [] indicates additional data provided from specimens located at FH, BPI, and/or the protologue. The latter type is designated by (lit.). The notation [lit.] is used only when specimens were not located and cites information strictly from the protologue.

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≡ *Xylosphaeria brachystoma* (Ell. & Ev.) Cke., Grevillea 17: 86. 1889.

Anthostomella cornicola Ell. & Ev., Erythea 1: 198. 1893.
WASHINGTON: Seattle, Aug 1892, *A. M. Parker 115* (HOLOTYPE: NY) [On twigs of *Cornus*, North Bend, Kings Co. (ISOTYPE: FH)] [On *Cornus pubescens* (ISOTYPE: BPI)]
≡ *Entosordaria cornicola* (Ell. & Ev.) Hoehn., Sber. Akad. Wiss. Wien Math.-nat. 129: 166. 1920.

Anthostomella eructans Ell. & Ev., in. Fairm., Proc. Rochester Acad. Sci. 1: 48. 1890.
On decorticated branch on ground, NEW YORK: Lyndonville, May 1889, *Dr. C. E. Fairman 42* (HOLOTYPE: NY)

Anthostomella hypsophila Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1894: 338. 1894.
On dead stems of *Lonicera involucrata*, NW COLORADO: Cameron Pass, 24 Jul 1894, *C. F. Baker 243* (HOLOTYPE: NY; ISOTYPE: FH)

Anthostomella leucobasis Ell. & Mart., see *Sphaeria leucobasis* Ell. & G. Martin.

Anthostomella ludoviciana Ell. & Langl., Proc. Acad. Nat. Sci. Philadelphia 1890: 228. 1890.

On dead *Smilax* sp. LOUISIANA: St. Martinsville, 21 Jan 1889, *A. B. Langlois 1696* (HOLOTYPE: NY; ISOTYPE: BPI)

Anthostomella magnoliae Ell. & Ev., J. Mycol. 4: 122. 1888.

On dejected *Magnolia* leaves, LOUISIANA: Pointe a La Hache, 14 Aug 1888, *A. B. Langlois 1480* (HOLOTYPE: NY; ISOTYPE: BPI) [Jul 1888, *A. B. Langlois 1480* (ISOTYPE: FH)]

≡ *Entosordaria magnoliae* (Ell. & Ev.) Hoehn., Sitzb. Akad. Wien 129: 166. 1920.

= *Anthostomella unguiculata* (Mont.) Sacc., fide Francis, Mycol. Pap. 139: 60. 1975.

Anthostomella mammoides Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1893: 139. 1893.

On *Ostrya*, CANADA: London, *Dearness 1801* (HOLOTYPE: NY) [On *Ostrya virginica*, Jun 1892 (ISOTYPE: FH)]

Anthostomella melanosticta Ell. & Ev., J. Mycol. 3: 44. 1887.

On old leaves of *Sabal palmetto*. LOUISIANA: Pointe a la Hache, Nov 1886, *A. B. Langlois 830* (HOLOTYPE: NY; ISOTYPE: FH) [23 Nov 1886 (ISOTYPE: BPI)] [Dec 1886 (lit.)]

Anthostomella minor Ell. & Ev., J. Mycol. 3: 43. 1887.

On petioles of *Sabal serrulata*, FLORIDA, Dec 1886, *W. W. Calkins 746* (HOLOTYPE: NY)

≡ *Anthostoma minor* (Ell. & Ev.) Muller, fide Muller & Dennis, Kew Bull. 19: 369. 1965.

Anthostomella ostiolata Ell. & Ev., Bull. Torrey Bot. Club 11: 42. 1884.

On *Laurus benzoin*, NEW JERSEY: Newfield, *J. B. Ellis s. n.* (HOLOTYPE: NY)

≡ *Anthostoma ostiolatum* (Ell. & Ev.) Cke., Grevillea 17: 90. 1889.

Anthostomella pholidigena (Ell.) Ell., see *Sphaeria pholidigena* Ell.

Anthostomella sabalensioides (Ell. & G. Martin) Sacc., see *Sphaeria sabalensioides* Ellis & G. Martin.

Anthostomella suberumpens Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1894: 338. 1894.

On inner side of weathered elm bark, KANSAS: Rockport, 13 Nov 1893, *E. Bartholomew 1244* (HOLOTYPE: NY; ISOTYPES: BPI, FH)

Anthostomella thyridioides Ell. & Ev., J. Mycol. 9: 167. 1903.

On dead *Populus deltoides*, KANSAS: Rooks Co., 18 Jul 1902, *E. Bartholomew 2969* (ISOTYPES: BPI, FH)

Ceriospora alabamiensis Ell. & Ev., N. Amer. Pyrenomyc. p. 391. 1892.

On herbaceous stems, ALABAMA, *# 1770* [*Atkinson* (lit.)] (HOLOTYPE:NY)

≡ *Urosporella alabamiensis* (Ell. & Ev.) Barr, Mycologia 58: 690. 1966.

Clypeosphaeria imperfecta Ell. & Ev., N. Amer. Pyrenomyc. p. 410. 1892.

On bark of living birch trees, NEW YORK: Syracuse, Jan 1887, *L. M. Underwood*, N. A. F. 2: 1960 (HOLOTYPE: NY, ISOTYPES: FH, BPI)

≡ *Pyrenula imperfecta* (Ell. & Ev.) R. C. Harris, Mich. Botanist 12: 43. 1973.

Clypeosphaeria minor Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1893: 138. 1893.

On bark of birch roots, CANADA: London, Apr 1892, *J. Dearness* (HOLOTYPE: NY; ISOTYPE: FH)

Clypeosphaeria sanguinea Ell. & Ev., N. Amer. Pyrenomyc. p. 409. 1892.

On dry hard wood, PENNSYLVANIA: Jan 1880, *Dr. J. W. Eckfeldt*; KANSAS, Winter 1884, *F. W. Cragin 134* (SYNTYPES: NY)

Clypeosphaeria ulmicola Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1893: 138. 1893.
On *Ulmus*, CANADA: London, Apr 1892, *Dearness 1776* (HOLOTYPE: NY; ISOTYPE: FH) [On dead elm limbs (ISOTYPE: BPI)]

Cryptosphaeria fissicola (Cke. & Ell.) Sacc., see *Sphaeria fissicula* Cke. & Ell.

Cryptosphaeria juglandina Ell. & Holw., Bull. Lab. Nat. Hist. Univ. 3(3): 41. 1895.
On *Juglans cinerea*, IOWA: Decorah, Jun 1892, *E. W. D. Holway* (ISOTYPE: BPI)
≡ *Engizostoma juglandinum* (Ell. & Holw.) Kuntze, Rev. Gen. Pl. 3(2): 474. 1898.

Diatrype acervata Ell. & Ev., J. Mycol. 4: 75. 1888.
On spots in leaves of *Yucca filamentosa*, NEW JERSEY: Newfield, 20 Jul 1888, *J. B. Ellis s. n.* (HOLOTYPE: NY; ISOTYPE: FH), and N. A. F. 2: 2124 (ISOTYPES: NY, BPI, FH)
≡ *Diaporthe acervata* (Ell. & Ev.) Ell. & Ev., N. Amer. Pyrenomyc. p. 738. 1892.
≡ *Valsa acervata* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3 (2): 539. 1892.
≡ *Mycosphaerella acervata* (Ell. & Ev.) Barr, Contr. Univ. Michigan Herb. 9: 596. 1972.

Diatrype aethiops Cke. & Ell., Grevillea 6: 10. 1877.
On *Morus*, NEW JERSEY: Newfield, near Malaga, Feb 1877, *J. B. Ellis s. n.* (ISOTYPE: BPI)
≡ *Valsaria aethiops* (Cke. & Ell.) Sacc., Syll. Fung. 1: 745. 1882.
≡ *Melogramma aethiops* (Cke. & Ell.) Cke., Grevillea 13: 109. 1885.
= *Valsaria insitiva* (Tode : Fr.) Ces. & De Not., fide Ell. & Ev., N. Amer. Pyrenomyc. p. 555. 1892.

Diatrype americana Ell. & Berl., Icon. Fung. 3: 94. 1902.
On *Magnolia*, NEW JERSEY: Newfield, Jun 1874, *J. B. Ellis s. n.* (TYPE: BPI)

Diatrype celastrina Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1894: 343. 1894.
On dead *Celastrus scandens*, KANSAS, 29 May 1894, *Bartholomew 1472* (HOLOTYPE: NY; ISOTYPE: FH)
≡ *Valsa celastrina* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 539. 1898.

Diatrype collariata Cke. & Ell., Grevillea 5: 32. 1876.
On hickory, NEW JERSEY: Newfield, *J. B. Ellis 539* (ISOTYPES: NY, FH)
= *Valsa caryigena* B. & C, fide Ell. & Ev., N. Amer. Pyrenomyc. p. 576. 1892.
≡ *Valsa collariata* (Cke. & Ell.) Kuntze, Rev. Pl. 3(2): 539. 1898.
≡ *Eutypella collariata* (Cke. & Ell.) Berl., Icon. Fung. 3: 76. 1902.

Diatrype comptoniae Ell. & Ev., J. Mycol. 2: 89. 1886.
On old stems of *Comptonia asplenifolia*, NEW JERSEY: Newfield, May 1886, *J. B. Ellis s. n.* (HOLOTYPE: NY; ISOTYPE: FH)
≡ *Thyridaria comptoniae* (Ell. & Ev.) Berl. & Voglino, fide Sacc., Syll. Fung. Addit. 1-4: 417. 1886.
≡ *Diatrypella comptoniae* (Ell. & Ev.) Ell. & Ev., Cat. Pl. New Jersey p. 536. 1889.
≡ *Pseudovalsa comptoniae* (Ell. & Ev.) Ellis & Ev., N. Amer. Pyrenomyc. p. 542. 1892.

Diatrype cornuta Ell. & Ev., N. Amer. Pyrenomyc. p. 568. 1892.
On dead bark of *Ailanthus glandulosus*, *# 259*, NEW YORK: Lyndonville, Apr 1891, *Charles E. Fairman* (HOLOTYPE: NY)
≡ *Valsa cornuta* [as "*cornula*"] (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 539. 1898.
= *Eutypella leprosa* (Pers. : Fr. : Fr.) Berl., fide Rappaz, Mycologia Helvetica 2(3): 461. 1987.

Diatrype disciformis var. *americana* Ell., see *Diatrype americana* Ell. & Berl.

Diatrype fibritecta Cke. & Ell., Grevillea 5: 31. 1876.

On *Juniperus virginiana*, NEW JERSEY: Newfield, *J. B. Ellis s. n.* (ISOTYPE: NY)
≡ *Valsa fibritecta* (Cke. & Ell.) Kuntze, Rev. Gen. Pl. 3(2): 540. 1898.

Diatrype hochelagae Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1890: 224. 1890.
On elm, "Hochelegae is an Indian name of the St. Lawrence River," [CANADA: London, Mar 1890, *J. Dearness* (lit.)] (HOLOTYPE: NY)
≡ *Valsa hochelagae* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 540. 1898.

Diatrype hullensis Ell. & Ev., N. Amer. Pyrenomyc. p. 567. 1892.
On rotten wood, CANADA: Quebec, West of Hull, 14 Sep 1891, *# 187* (HOLOTYPE: NY) [*Macoun* (lit.)].
= *Eutypa flavovirens* (Pers. : Fr.) Tul., fide Glawe & Rogers, Mycotaxon 20: 439. 1984.
= *Diatrype flavovirens* (Pers. : Fr.) Fr., fide Rappaz, Mycologia Helvetica 2(3): 406. 1987.

Diatrype infuscans Ell. & Ev., N. Amer. Pyrenomyc. p. 571. 1892.
On *Smilax*, TEXAS: Houston, 14 Apr 1869, *H. W. Ravenel* (HOLOTYPE: NY)
= *Eutypella quadrifida* (Schwein.) Ell. & Ev., fide Rappaz, Mycologia Helvetica 2(3): 488. 1987.

Diatrype irregularis Cke. & Ell., Grevillea 6: 92. 1878.
On old pear tree limbs lying on the ground, NEW JERSEY: Newfield, 14 Sep 1878, *J. B. Ellis s. n.* (ISOTYPE: NY)
≡ *Diatrypella irregularis* (Cke. & Ellis) Sacc., Syll. Fung. 1: 207. 1882.

Diatrype lateritia Ell., Bull. Torrey Bot. Club 9: 19. 1882.
On *Carpinus*, PENNSYLVANIA: W. Chester, Aug 1879, *J. H. Wright* (HOLOTYPE: NY)
≡ *Thyridaria lateritia* (Ell.) Sacc., Syll. Fung. 2: 141. 1883.
≡ *Melogramma lateritia* (Ell.) Cooke, Grevillea 13: 109. 1885.
= *Melogramma vagans* De Not., fide Berl., Icon. Fung. 1: 46. 1891.
= *Melogramma campylosporum* Fr., fide LaFlamme, Sydowia 28: 240. 1975

Diatrype linearis Ell. & Ev., Bull. Torrey Bot. Club 24: 134. 1897.
On *Eucalyptus globulus*, CALIFORNIA: Compton, 11 Dec 1896, *McClatchie* (HOLOTYPE: NY)
= *Diatrype prominens* Cke. & Harkn., fide Rappaz, Mycologia Helvetica 2(3): 430. 1987.

Diatrype maclurae Ell. & Ev., N. Amer. Pyrenomyc. p. 570. 1892.
On Osage orange, CANADA: London, 11 May 1891 (HOLOTYPE: NY) [*Dearness 579* (ISOTYPE: FH)]
= *Eutypella leprosa* (Pers. ex Fr. : Fr.) Berl., fide Rappaz, Mycologia Helvetica 2(3): 461. 1987.

Diatrype macounii Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1890: 224. 1890.
On maple bark, BRITISH COLUMBIA, 1889, *Macoun 127* (HOLOTYPE: NY) [20 May 1889 (ISOTYPE: FH)]
≡ *Valsa macounii* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 540. 1898.
= *Diatrype bullata* (Hoffm. : Fr.) Fr., fide Glawe & Rogers, Mycotaxon 20: 419. 1984.

Diatrype megastoma Ell. & Ev., J. Mycol 1: 141. 1885.
On dead alders, NEW JERSEY: Newfield, 20 Jul 1885 (ISOTYPE: FH) N. A. F. 2: 1556 (ISOTYPES: NY, BPI) [*Alnus serrulata* (lit.)].
≡ *Valsa megastoma* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 540. 1898.
= *Eutypella cerviculata* (Fr. : Fr.) Sacc, fide Rappaz, Mycologia Helvetica 2(3): 527. 1987.

Diatrype microspora Ell., Bull. Torrey Bot. Club 8: 74. 1881.
On alder, MAINE: Wells, *Rev. J. Blake*, Herb. Ellis (ISOTYPE: BPI)
= *Anthostoma ellisii* Sacc., Syll. Fung. 1: 308. 1882.
≡ *Anthostoma microsporum* Karst., fide Ell. & Ev., N. Amer. Pyrenomyc. p. 582. 1892.
≡ *Camarops microspora* (P. Karst.) Shear, Mycologia 30: 588. 1938.

Diatrype microstega Ell. & Ev., N. Amer. Pyrenomyc. p. 574. 1892.
On bark, CALIFORNIA, *Dr. Harkness 1877* (HOLOTYPE: NY)
≡ *Valsa microstega* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 540. 1898.
= *Diatrype prominens* Cke. & Harkn., fide Rappaz, Mycologia Helvetica 2: 430. 1987.

Diatrype minima Ell. & Ev., J. Mycol. 1: 91. 1885.
On *Magnolia*, Apr 1885, *J. B. Ellis s. n.* (HOLOTYPE: NY) [NEW JERSEY: Newfield (ISOTYPE: FH)]
≡ *Valsa minima* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 540. 1898.

Diatrype nigerrima Ell. & Ev., J. Mycol. 10: 170. 1904.
On bark of *Vitis*, ILLINOIS: Glencoe, Jun 1893, *E. T. & S. A. Harper* (HOLOTYPE: NY) [Ex Herb. E. T. & S. A. Harper, # 904, Jun 1903 (ISOTYPE: FH)]
= *Eutypella aequilinearis* (Schwein. : Fr.) Starb., fide Rappaz, Mycologia Helvetica 2: 473. 1987.

Diatrype olivacea (Cke. & Ell.) Ell., see *Diatrypella olivacea* Cke. & Ell.

Diatrype phaeosperma Ell., Amer. Naturalist 17: 195. 1883.
On *Amelanchier canadensis*, IOWA: Decorah, 23 Aug 1882, *E. W. Holway 228* (HOLOTYPE: NY; ISOTYPE: FH)
≡ *Anthostoma phaeospermum* (Ell.) Sacc., Syll. Fung. 2: xiv. 1883.
≡ *Fuckelia phaeospermum* (Ell.) Cke., Grevillea 12: 52. 1883.

Diatrype pustulans Ell. & Ev., J. Mycol. 4: 80. 1888.
On dead stems of *Arundinaria*, LOUISIANA: St. Martinsville, *Rev. A. B. Langlois 1215* (partly) (ISOTYPE: FH)
≡ *Valsaria pustulans* (Ell. & Ev.) Sacc., Syll. Fung. 9: 758. 1891.

Diatrype quercina Fr. var. *lignicola* Cke. & Ell., Grevillea 5: 54. 1876.
On decorticated oak branches, NEW JERSEY: Newfield, *J. B. Ellis # 2412* (lit.)
= *Cryptovalsa eutypaeformis* Sacc., fide Ell. & Ev., N. Amer. Pyrenomyc. p. 517. 1892.
= *Allescherina eutypaeformis* (Sacc.) Berl., Icon. Fung. 3: 110. 1905.

Diatrype radiata Ell., Amer. Naturalist 17: 195. 1883.
On dead limbs of elm, IOWA: Decorah, Sep 1882, *E. W. Holway 266*, (HOLOTYPE: NY; ISOTYPE: FH)
≡ *Valsa radiata* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 540. 1898.
= *Eutypella leprosa* (Pers. ex Fr. : Fr.) Berl., fide Rappaz, Mycologia Helvetica 2: 461. 1987.

Diatrype rhuina Cke. & Ell., Grevillea 7: 8. 1878.
On *Rhus venenata*, NEW JERSEY: Newfield, Feb 1878 & Dec 1878, *J. B. Ellis s. n.* (SYNTYPES: NY, BPI)
≡ *Calospora rhoina* (Cke. & Ell.) Sacc., Syll. Fung. 2: 234, 1883.
≡ *Diaporthe rhoina* (Cke & Ell.) Ell. & Ev., N. Amer. Pyrenomyc. p. 424. 1892.

Diatrype sphaerospora Ell. & Ev., J. Mycol. 3: 42. 1887.
On *Magnolia glauca*, NEW JERSEY: Newfield, Jun 1878, *J. B. Ellis s. n.* (HOLOTYPE: NY; ISOTYPE: FH)

Diatrype texensis Ell. & Ev., J. Mycol. 2: 40. 1886.
On fallen limbs, TEXAS: Houston, Apr 1869, *H. W. Ravenel* (ISOTYPES: BPI, FH)
≡ *Thyridaria texensis* (Ell. & Ev.) Berl. & Vogl., Syll. Fung. Addit. 1-4: 164. 1886.
≡ *Pseudovalsa texensis* (Ell. & Ev.) Ell. & Ev., N. Amer. Pyrenomyc. p. 541. 1892.

Diatrype tiliacea Ell., Amer. Naturalist 17: 195. 1883.
On *Tilia americana*, IOWA: Ames, Oct 1882, *J. C. Arthur 86* (HOLOTYPE: NY)

≡ *Hercospora tiliacea* (Ell.) Sacc., Syll. Fung. 9: 702. 1891.
≡ *Melanconis tiliacea* (Ell.) Ell. & Ev., N. Amer. Pyrenomyc. p. 524. 1892.
≡ *Diaporthe tiliacea* (Ell.) Hoehn, fide Wehm., Univ. Michigan Stud. Sci. Ser. 9: 185. 1933.
≡ *Phragmodiaporthe tiliacea* (Ell.) Barr, Mycologia Mem. 7: 155. 1978.

Diatrype tremellophora Ell., Amer. Naturalist 16: 239. 1882.
On *Magnolia glauca*, NEW JERSEY: Newfield, 1875, *J. B. Ellis s. n.*, "as *Diatrype disciformis* Fr. var. *magnoliae* Thm." (HOLOTYPE: NY)
= *Diatrype disciformis* (Hoffm.) Fr. var. *magnoliae* Thuem., Bull. Torrey Bot. Club 6: 95. 1896.

Diatrype trifida Ell. & Macbr., Bull. Lab. Nat. Hist. Univ. Iowa 4: 71. 1896.
On wood, MEXICO: Tehuantepec, 1895, *C. L. Smith* (HOLOTYPE: NY)

Diatrype tumida Ell. & Ev., N. Amer. Pyrenomyc. p. 567. 1892.
On elm bark, CANADA: London, Feb 1890, *J. Dearness* (ISOTYPE: FH)
≡ *Valsa tumida* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 540. 1898.
≡ *Eutypella tumida* (Ell. & Ev.) Wehm., Pap. Michigan Acad. Sci. 5: 179. 1926.

Diatrype vitis (Ell. & Ev.) Sacc., see *Diatrypella vitis* Ell. & Ev.

Diatrypella citricola Ell. & Ev., N. Amer. Pyrenomyc. p. 587. 1892.
On dead orange twigs, FLORIDA: Sandford, Apr 1891, *L. M. Underwood 2377* (HOLOTYPE: NY; ISOTYPES: NY, BPI, FH)
≡ *Cryptovalsa citricola* (Ell. & Ev.) Berl., fide Abbado, Malpighia 16: 320. 1902.

Diatrypella decipiens Ell. & Ev., J. Mycol. 4: 80. 1888.
On bark of *Umbellularia californica*, OREGON: Coos Co., Feb 1884, *W. S. Carpenter* (HOLOTYPE: NY; ISOTYPE: FH)

Diatrypella demetrionis Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1890: 225. 1890.
On dead limbs of *Salix chlorophylla*, in a wet mountain valley, COLORADO, Jul 1888, *Demetrio 205* (HOLOTYPE: FH)

Diatrypella deusta Ell. & Martin, Amer. Naturalist 16: 809. 1882.
On petioles of *Sabal serrulata*, FLORIDA, Winter 1882, *Dr. Geo. Martin* (HOLOTYPE: NY) [Green Cove Springs, Herb. S. M. Tracy (ISOTYPE: BPI)] N. A. F.: 1184 (ISOTYPES: NY, BPI, FH)
≡ *Allescherina deusta* (Ell. & Martin) Berl., fide Abbado, Malpighia 16: 303. 1902.
≡ *Cryptovalsa deusta* (Ell. & Martin) Petrak, Sydowia 7: 103. 1953.

Diatrypella fraxini Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1895: 426. 1895.
On dead *Fraxinus viridis*, KANSAS, 22 Jul 1895, *Bartholomew 1783* (HOLOTYPE: NY)

Diatrypella herbacea Ell. & Ev., J. Mycol. 3: 42. 1887.
On dead (short?) stems of high weeds [*Ambrosia trifida* (lit.)], 1 Sep 1886, LOUISIANA: St. Gabriel, *Langlois 505* (HOLOTYPE: NY; ISOTYPES: BPI,FH).

Diatrypella hysterioides Ell. & Ev., J. Mycol. 2: 99. 1886.
On piece of poplar in a willow jungle, *# 380*, LOUISIANA, 29 Jan 1886, (HOLOTYPE: NY, ISOTYPE: BPI) [*Langlois 380* (ISOTYPE: FH)]

Diatrypella irregularis (Cke. & Ell.) Sacc., see *Diatrype irregularis* Cke. & Ell.

Diatrypella missouriensis Ell. & Ev., N. Amer. Pyrenomyc. p. 586. 1892.
On *Corylus*, MISSOURI: Concordia, Jan 1888, *Rev. C. H. Demetrio 75*. (HOLOTYPE: NY)

Diatrypella obscurata Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1895: 27. 1895.
On limbs of some shrub or tree, PENNSYLVANIA: Bethlehem, *Schw.* [lit.].

Diatrypella olivacea Cke. & Ell., Grevillea 6: 9. 1877.
On *Nyssa*, NEW JERSEY: Newfield, *J. B. Ellis s. n.* (ISOTYPE: FH)
≡ *Diatrype olivacea* (Cke. & Ell.) Ell., Prel. Cat. Fl. New Jersey p. 198. 1881.
= *Diatrypella subfulva* (B. & C.) Sacc., sec. Cke., fide Ell. & Ev. N. Amer. Pyrenomyc. p. 594. 1892.

Diatrypella paupera Ell. & Ev., Bull. Iowa Univ. Lab. Nat. Hist. 2: 404. 1893.
On dead branch, NICARAGUA: Castillo Viejo, Feb 1893, *C. L. Smith* (HOLOTYPE: NY; ISOTYPE: BPI)

Diatrypella populi Ell. & Holw., J. Mycol. 1: 4. 1885.
On poplar, IOWA: Decorah, Aug 1883, *Holway 349* (HOLOTYPE: NY)

Diatrypella prunicola Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1894: 344. 1894.
On *Prunus pennsylvanica*, NEW YORK: Alcove, Feb 1894, *C. L. Shear 298* (HOLOTYPE: NY); New York Fungi # 337 (ISOTYPES: NY, BPI, FH).

Diatrypella pulcherrima Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1893: 144. 1893.
On willow twigs and buds, *Dearness 1875* (HOLOTYPE: NY) [On dead twigs of *Salix*, CANADA: London, 24 May 1892 (ISOTYPE: FH)] [possible ISOTYPE in BPI, ex Herb. Ellis)
≡ *Valsella pulcherrima* (Ell. & Ev.) Berl, Icon. Fung. 3: 106. 1905.

Diatrypella pustulata Ell. & Ev., J. Mycol. 3: 116. 1887.
On *Lonicera*, NEW JERSEY: Newfield, May 1887, *J. B. Ellis s. n.* (HOLOTYPE: NY; ISOTYPE: FH)
≡ *Cryptovalsa pustulata* (Ell. & Ev.) Ell. & Ev., N. Amer. Pyrenomyc. p. 516. 1892.

Diatrypella ramularis Ell. & Ev., J. Mycol. 3: 42. 1887.
On dead vines of *Lonicera japonica*, LOUISIANA: Pointe a la Hache, 9 Dec 1886, *A. B. Langlois 861* (HOLOTYPE: NY; ISOTYPES: BPI, FH)

Diatrypella sassafras Ell. & Ev., N. Amer. Pyrenomyc. p. 588. 1892.
On dead limbs of *Sassafras*, NEW JERSEY: Newfield, 29 Mar 1891, *J. B. Ellis s. n.* (HOLOTYPE: NY; ISOTYPE: FH)
≡ *Cryptovalsa sassafras* (Ell. & Ev.) Berl., fide Abbado, Malpighia 16: 311. 1902.

Diatrypella tocciaeana De N. var. *subeffusa* Ell. & Ev., J. Mycol. 4: 62. 1888.
On bark of dead alder, MASSACHUSETTS, *Rev. Jos. Blake* [lit.].
= *Diatrypella verrucaeformis* (Ehr. : Fr.) Nits., fide Ell. & Ev., N. Amer. Pyrenomyc. p. 584. 1892.

Diatrypella vetusta Ell. & Ev., J. Mycol. 9: 168. 1903.
On decorticated sticks, ILLINOIS: River Forest, Oct 1902, *E. J. Harper* (ISOTYPE: FH)

Diatrypella vitis Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1890: 225. 1890.
On dead vines of *Vitis bipinnata*, LOUISIANA: Pointe a la Hache, Bayou Chene, 25 Oct 1888, *A. B. Langlois 1508* (HOLOTYPE: NY; ISOTYPES: BPI, FH)
≡ *Diatrype vitis* (Ell. & Ev.) Sacc., Syll. Fung. 9: 476. 1891.
≡ *Valsa vitis* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 540. 1898.

Diatrypella xanthostroma Ell. & Ev., J. Mycol. 9: 225. 1903.
On *Pirus japonica*, CANADA: London, 3 Nov 1903, *Dearness 2045* (HOLOTYPE: NY; ISOTYPE: FH) [On *Cydonia japonica*, Rehm: Ascomycetes, # 1985 (ISOTYPE: BPI)]

Eutypa echinata Ell. & Ev., J. Mycol. 3: 43. 1887.
On dead shoots of *Fraxinus*, LOUISIANA: Plaquemines Co., 29 Dec 1886, *A. B. Langlois 952* (HOLOTYPE: NY; ISOTYPE: FH)
= *Eutypa heteracantha* Sacc., fide Ell. & Ev. N. Amer. Pyrenomyc. p. 100 502. 1892.
≡ *Engizostoma echinatum* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 474. 1898.
= *Peroneutypa heteracantha* Sacc., fide Berl., Icon. Fung. 3: 81. 1968.
= *Eutypella scoparia* (Schwein. : Fr.) Ell. & Ev., fide Rappaz, Mycologia Helvetica 2: 537. 1987.

Eutypella aesculina Ell. & Ev., Erythea 1: 146. 1893.
On *Aesculus californica*, CALIFORNIA: Berkeley, 23 Apr 1893, *W. C. Blasdale 111* (HOLOTYPE: NY; ISOTYPE: BPI)
≡ *Engizostoma aesculinum* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 473. 1898.
= *Eutypella scoparia* (Schwein. : Fr.) Ell. & Ev., fide Rappaz, Mycologia Helvetica 2: 538. 1987.

Eutypella alpina Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1895: 425. 1895.
On dead trunks of *Alnus incana*, COLORADO: Larimer Co., 11 Jul 1895, *C. F. Baker 363* (ISOTYPES: FH, BPI) N. A. F.: 3331 (ISOTYPES: NY, BPI)
≡ *Engizostoma alpinum* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 473. 1898.
= *Eutypella cerviculata* (Fr. : Fr.) Sacc., fide Rappaz, Mycologia Helvetica 2: 527. 1987.

Eutypella amorphae Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1893: 140. 1893.
On *Amorpha fruticosa*, 12 Dec 1892, *# 822* (HOLOTYPE: NY) [KANSAS: Rockport, *Bartholomew 822* (ISOTYPES: BPI, FH)] N. A. F. 2: 2931 (ISOTYPES: NY, BPI)
≡ *Engizostoma amorphae* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 473. 1898.
= *Eutypella tetraploa* (Berk. & Curt. ex Berk. & Broome) Sacc., fide Rappaz, Mycologia Helvetica 2: 511. 1987.

Eutypella canodisca (Ell. & Holw.) Sacc., see *Valsa canodisca* Ell. & Holw.

Eutypella capillata (Ell. & Ev.) Ell. & Ev., see *Valsa capillata* Ell. & Ev.

Eutypella carpinicola Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1894: 342. 1894.
On *Carpinus americana*, NEW YORK: Alcove, Oct 1893, C. L. Shear (HOLOTYPE: NY; ISOTYPE: BPI) [On *Carpinus caroliniana* (ISOTYPE: FH)] N. A. F.: 3028 (ISOTYPES: NY, FH)
≡ *Engizostoma carpinicola* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 473. 1898.
≡ *Massalongella carpinicola* (Ell. & Ev.) Berl., Icon. Fung. 3: 1. 1968.

Eutypella coryli Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1893: 143. 1893.
On *Corylus*, CANADA: London, *Dearness 1872* (HOLOTYPE: NY) [Jun 1892 (ISOTYPE: FH)]
≡ *Engizostoma coryli* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 473. 1898.

Eutypella densissima Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1894: 341. 1894.
On dead limbs of *Aralia spinosa*, WEST VIRGINIA: Fayette Co., 24 Feb 1894, *L. W. Nuttall 363* (HOLOTYPE: NY; ISOTYPE: FH)
≡ *Engizostoma densisimmum* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 473. 1898.

Eutypella deusta (Ell. & Ev.) Ell. & Ev., see *Valsa deusta* Ell. & Ev.

Eutypella exigua Ell. & Ev. ex Berl., Icon. Fung. 3: 58. 1902.
On dead elm branches, CANADA: London, 22 Feb 1890, *J. Dearness 1443* (ISOTYPE: FH)
= *Eutypella scoparia* (Schwein. : Fr.) Ell. & Ev., fide Rappaz, Mycologia Helvetica 2: 538. 1987.

Eutypella fici Ell. & Ev., Bull. Torrey Bot. Club 24: 133. 1897.
On a dead piece of fig tree, LOUISIANA: St. Martinsville, 26 Mar 1896, *A. B. Langlois 2443* (HOLOTYPE: NY; ISOTYPES: BPI, FH)

= *Eutypella scoparia* (Schwein. : Fr.) Ell. & Ev., fide Rappaz, Mycologia Helvetica 2: 538. 1987.

Eutypella herbicola Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1895: 426. 1895.
On *Aster cordifolius*, OHIO, *Morgan 1122* (ISOTYPE: FH)
≡ *Engizostoma herbicola* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 474. 1898.
= *Eutypella goniostoma* (Schwein.) Sacc., fide Rappaz, Mycologia Helvetica 2: 491. 1987.

Eutypella juglandina (Cke. & Ell.) Sacc., see *Valsa juglandina* Cke. & Ell.

Eutypella lutescens (Ell.) Sacc., see *Valsa lutescens* Ell.

Eutypella maclurae (Cke. & Ell.) Ell. & Ev. See *Valsa maclurae* Cke. & Ell.

Eutypella microcarpa (Ell. & Ev.) Sacc. See *Valsa microcarpa* Ell. & Ev.

Eutypella populi Ell. & Ev., Amer. Naturalist 31: 342. 1897.
On poplar twigs, CANADA, 29 Sep 1896, # 113, *Macoun* (HOLOTYPE: NY) [On dead limbs of *Populus* (lit.)]

Eutypella rugiella (Cke. & Ell.) Sacc., see *Valsa rugiella* Cke. & Ell.

Eutypella sarcobati Ell. & Ev., Bull. Torrey Bot. Club 24: 462. 1897.
On *Sarcobatus vermiculatus*, COLORADO: Alamosa, 12 Jul 1897, *Bethel 324* (HOLOTYPE: NY; ISOTYPES: BPI, FH)

Eutypella tiliae Ell. & Ev., Bull. Torrey Bot. Club 24: 280, 1897.
On dead wood, Canada, # 432, 22 Oct 1896, *Macoun* (?HOLOTYPE: NY). [On bark of dead *Tilia americana*, (lit.)].

Eutypella venusta (Ell.) Sacc., see *Valsa venusta* Ell.

Hypoxylon albocinctum Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1890: 229. 1890.
On bark of dead *Crataegus*, OHIO: Preston, Hamilton Co., 10 Jan 1890, *A. P. Morgan 884* (HOLOTYPE: NY). [On bark of *Ostrya virginica*, (ISOTYPE: FH)]
Ostrya virginica was originally given as the host on the holotype packet (NY); *Crataegus* was later written over that name.

Hypoxylon atrorufum Ell. & Ev., N. Amer. Pyrenomyc. p. 742. 1892.
On bark, MICHIGAN, Jan 1892, *G. H. Hicks 165* (HOLOTYPE: NY)
= *Hypoxylon cohaerens* Pers. ex Fr., fide Miller, A Monograph of the world species of *Hypoxylon*, p. 46, 1961. [According to Ellis (1892) the host is oak(?). According to Cash (1953), and Shear (1946), the host is *Fagus*].

Hypoxylon atroviride Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1894: 346. 1894.
On bark of dead trees (birch or oak), WEST VIRGINIA: Nuttallburg, *L. W. Nuttall 275*. (HOLOTYPE: NY) [16 Dec 1893 (ISOTYPE: FH)] [*L. Nuttall 1320* (*J. B. E. 275*) ISOTYPE: BPI]
= *Bolinia tubulina* (Alb. & Schw. : Fr.) Sacc., Syll. Fung. 1: 352. 1882.
≡ *Camarops tubulina* (Alb. & Schw. : Fr.) Shear, Mycologia 30: 568. 1938.
= *Camarops ohiensis* (Ell. & Ev.) Nannfeldt, Svensk Bot. Tidskr. 66(4): 365. 1972.

Hypoxylon bicolor Ell. & Ev., J. Mycol. 2: 88. 1886.
On dead branches of *Quercus virens*, LOUISIANA: Pointe a la Hache, *A. B. Langlois 344* (HOLOTYPE: NY; ISOTYPE: FH)
= *Hypoxylon rubiginosum* Pers. : Fr., fide Miller, A Monograph of the world species of *Hypoxylon*, p. 29, 1961.

= *Hypoxylon bicoloratum* P. Martin, J. S. African Bot. 42: 72. 1976.

Hypoxylon californicum Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1895: 426. 1895.

On wood of *Adenostylum fasciculatum*, CALIFORNIA: [Pasadena (lit.)], 5 Aug 1894, *A. J. McClatchie 755* (HOLOTYPE: NY)

= *Hypoxylon rubrostromaticum* Mill., A Monograph of the world species of *Hypoxylon*, p. 24, 1961.

Hypoxylon cinereum Ell. & Ev., N. Amer. Pyrenomyc. p. 647. 1892.

On decaying pieces, LOUISIANA: near St. Martinsville, 28 Mar 1890, *A. B. Langlois 2278* (HOLOTYPE: NY; ISOTYPES: BPI, FH)

= *Hypoxylon hypophlaeum* (Berk. & Rav.) Mill., Mycologia 33: 75. 1941.

Hypoxylon commutatum Nits. subsp. *holwayanum* Sacc. & Ell., Michelia 2: 570. 1882.

On oak, *# 3679*, IOWA: Decorah, Jul 1883, *E. W. Holway* (HOLOTYPE: NY). [On plum, 21 Jul 1883 (ISOTYPE: FH)]

= *Hypoxylon rubiginosum* Pers. : Fr., fide Miller, A Monograph of the world species of *Hypoxylon*, p. 29. 1961.

Hypoxylon cylindrophorum Ell. & Ev., Bull. Iowa Univ. Lab. Nat. Hist. 2: 407. 1893.

On dry hard wood, NICARAGUA: Lake Nicaragua, Island of Ometepe, Winter 1893, Central American Fungi (C. A. F.) # 82, *C. L. Smith* (HOLOTYPE: NY)

= *Camarops polyspermum* (Mont.) Miller, Trans. Brit. Mycol. Soc. 15: 151. 1930.

≡ *Numulariola cylindrophora* (Ell. & Ev.) P. Martin, J. S. African Bot. 42: 76. 1976.

Hypoxylon discoideum Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1893: 450. 1893.

On dead stem of climbing *Rhus toxicodendron*, NEW JERSEY: Newfield, Dec 1892, *J. B. Ellis s. n.* (HOLOTYPE: NY) [In the swamp (ISOTYPE: FH)]

= *Hypoxylon investiens* (Schw.) Curt., fide Miller, A Monograph of the world species of *Hypoxylon*, p. 49. 1961.

Hypoxylon fibuliforme Ell. & Ev., Bull. Iowa Univ. Lab. Nat. Hist. 4: 71. 1896.

[On dead wood (lit.)], NICARAGUA: Indian River, Mar 1896, *C. L. Smith 12* (HOLOTYPE: NY) [near Greytown, Charles L. Smith 131, Central American Fungi (ISOTYPE: BPI)]. According to Miller (1961) the type specimen is too old to make a determination and the species is excluded.

Hypoxylon holwayii Ell., Amer. Naturalist 17: 193. 1883.

On poplar, IOWA: Decorah, Jul 1882, *E. W. Holway 145* (HOLOTYPE: NY), and N. A. F.: 1182 (ISOTYPES: NY, FH).

= *Hypoxylon mammatum* (Wahl.) Miller, A Monograph of the world species of *Hypoxylon*, p.64. 1961.

Hypoxylon lucidum Ell. & Ev., Bull. Iowa Univ. Lab. Nat. Hist. 4: 72. 1896.

On dead wood, NICARAGUA (*C. L. Smith*) [lit.].

= *Hypoxylon haematostroma* Mont., fide Miller, A Monograph of the world species of *Hypoxylon*, p. 36. 1961.

Hypoxylon morgani Ell. & Ev., N. Amer. Pyrenomyc. p. 648. 1892.

On rotten wood, OHIO, *A. P. Morgan 890* (HOLOTYPE: NY)

Hypoxylon multiforme Fr. var. *effusum* Cke. & Ell., Grevillea 5: 33. 1876.

On maple, NEW JERSEY: Newfield, Oct 1876, *J. B. Ellis 569* (ISOTYPE: NY)

= *Sphaeria multiformis* Fr. f. *effusa* Fr., Syst. Mycol. 2: 334. 1823.

= *Hypoxylon rubiginosum* Pers. : Fr., fide Miller, A Monograph of the world species of *Hypoxylon*, p. 29. 1961.

Hypoxylon nicaraguense Ell. & Ev., Bull. Iowa Univ. Lab. Nat. Hist. 2: 407. 1893.
On wood, NICARAGUA: Ometepe (a), and near Castillo Viejo (b), Feb 1893, C. A. F. 26, *B. Shimek* (SYNTYPES: NY, BPI)
= *Hypoxylon sclerophaeum* Berk. & Curt., fide Miller, A Monograph of the world species of *Hypoxylon*, p. 42. 1961.

Hypoxylon nuttallii Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1894: 346. 1894.
On *Magnolia fraseri*, WEST VIRGINIA: Nuttallburg, 4 May 1894, *L. W. Nuttall 477* (HOLOTYPE: NY; ISOTYPE: BPI)
= *Hypoxylon rubiginosum* Pers. : Fr., fide Miller, A Monograph of the world species of *Hypoxylon*, p. 30. 1961.

Hypoxylon occidentale Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1894: 345. 1894, nom Ell. & Morg. ex Martin, J. S. African Bot. 42: 82. 1976.
On dead limbs, CALIFORNIA: Pasadena, Mar 1894, *Prof. A. J. McClatchie* (HOLOTYPE: NY; ISOTYPE: FH) and N. A. F. 2: 3127 (ISOTYPES: NY, FH).
= *Hypoxylon thouarsianum* (Lév.) Lloyd, Myc. Writ. 5: 26. 1919.

Hypoxylon occidentale Ell. & Morgan ex Martin, J. S. African Bot. 42: 82. 1976.
On *Liriodendron*, OHIO: *Morgan 621* (HOLOTYPE NY)

Hypoxylon ohiense Ell. & Ev., N. Amer. Pyrenomyc. p. 648. 1892.
On rotten wood, OHIO: *A. P. Morgan 883* (LECTOTYPE: NY) and *965* (PARATYPE: NY)
= *Bolinia tubulina* (Alb. & Schw.: Fr.) Sacc., Syll. Fung. 1: 352. 1882.
≡ *Camarops ohiensis* (Ell. & Ev.) Nannfeldt, Svensk Bot. Tidskr. 66(4): 365. 1972.

Hypoxylon pallidum Ell. & Ev., J. Mycol. 4: 68. 1888.
[On bark of dead oak limbs, LOUISIANA (lit.)] Catahoula, *Langlois 1273*, ex Herb. A. B. Langlois (ISOTYPE: BPI)
= *Hypoxylon notatum* Berk. & Curt., fide Miller, A Monograph of the world species of *Hypoxylon*, p. 20. 1961.

Hypoxylon papillatum Ell. & Ev., Bull. Iowa Univ. Lab. Nat. Hist. 2: 408. 1893.
On decaying wood of various deciduous trees, KANSAS, Winter 1884, *F. W. Cragin 140*. OHIO, Autumn 1883, *A. P. Morgan 294*. DELAWARE, Jul 1893, *A. Commons 2160*. NICARAGUA, Winter 1893, *C. L. Smith 57* (SYNTYPES: NY)

Hypoxylon piceum Ell., Amer. Naturalist 17: 194. 1883.
On rotten wood, IOWA: Decorah, Oct 1882, *E. W. Holway 289* (HOLOTYPE: NY) [*E. W. Holway 287* (lit.)].
= *Hypoxylon rubiginosum* Pers.: Fr., fide Miller, Bothalia 4: 258. 1942.
= *Hypoxylon sclerophaeum* Berk. & Curt., fide Miller, A Monograph of the world species of *Hypoxylon*, p. 42. 1961.

Hypoxylon platystomum Ell. & Ev., N. Amer. Pyrenomyc. p. 649. 1892.
On cross cuttings of *Melia*, LOUISIANA: St. Martinsville, 25 Oct 1890, *A. B. Langlois 2333* (HOLOTYPE: NY; ISOTYPE: FH)
= *Hypoxylon stygium* (Lév.) Sacc., fide Miller, A Monograph of the world species of *Hypoxylon*, p. 91. 1961.

Hypoxylon subchlorinum Ell. & Calkins, J. Mycol. 4: 86. 1888.
On bark of dead limbs of some deciduous tree, FLORIDA: Jacksonville, Winter 1886, *W. W. Calkins*, N. A. F. 2: 2115 (ISOTYPES: NY, FH)
= *Hypoxylon rubiginosum* Pers. : Fr., fide Miller, A Monograph of the world species of *Hypoxylon*, p. 27. 1961.

Hypoxylon subluteum Ell. & Ev., N. Amer. Pyrenomyc. p. 648. 1892.
On decaying soft wood, LOUISIANA: Near St. Martinsville, 24 Aug 1890, *A. B. Langlois 2276* (HOLOTYPE: NY)
= *Hypoxylon rubiginosum* Pers. : Fr., fide Miller, Bothalia 4: 258. 1942.
= *Hypoxylon serpens* (Pers. : Fr.) Kickx, fide Miller, A Monograph of the world species of *Hypoxylon*, p. 80. 1961.
= *Hypoxylon bipapillatum* Berk. & Curt., fide Petrini & Rogers, Mycotaxon 26: 408. 1986.

Hypoxylon vernicosum Ell. & Ev., Amer. Naturalist 31: 426. 1897.
On rotten wood, sent from Ohio as *H. marginatum*, OHIO: *A. P. Morgan* (HOLOTYPE: NY)
= *Hypoxylon truncatum* (Schw. : Fr.) Mill., Trans. Brit. Mycol. Soc. 17: 130. 1932.

Kretzschmaria pusilla Ell. & Ev., Bull. Iowa Univ. Lab. Nat. Hist. 2: 410. 1893.
On fallen tree trunks, NICARAGUA: Castillo Viejo, Feb 1893, C. A. F. 29, *C. L. Smith* (HOLOTYPE: NY) [C. L. Smith 72 (ISOTYPE: BPI)]
= *Kretzschmaria clavus* (Fr.) Sacc., Syll. Fung. 2: 29. 1883.

Kretzschmaria spinifera Ell. & Macbr., Bull. Iowa Univ. Lab. Nat. Hist. 4: 71. 1896.
On decaying bark, MEXICO, 1895, *C. L. Smith* (HOLOTYPE: NY; ISOTYPES: NY, BPI)

Nummularia albosticta Ell. & Morg., Bull. Torrey Bot. Club 24: 135. 1897.
On hickory, OHIO: [Preston (lit.)], *A. P. Morgan 1178* (HOLOTYPE: NY) [On dead *Carya* (ISOTYPE: FH)]
≡ *Hypoxylon albostictum* (Ell. & Morg.) Miller, Mycologia 25: 325. 1933.
≡ *Numulariola albosticta* (Ell. & Morg.) P. Martin, J. S. African Bot. 42: 75. 1976.

Nummularia lateritia Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1893: 144. 1893.
On bark of dead *Fraxinus sambucifolia*, CANADA: London, Mar 1892, *J. Dearness 1283* (ISOTYPE: FH).
≡ *Kommamyce lateritia* (Ell. & Ev.) Niewland, Amer. Midl. Naturalist 4: 375. 1916.
= *Hypoxylon rubiginosum* Pers. : Fr., fide Miller, A Monograph of the world species of *Hypoxylon*, p. 27. 1961.

Nummularia pezizoides Ell. & Ev., Bull. Torrey Bot. Club 11: 74. 1884.
On bark, CANADA: Ottawa, Oct 1883, *Macoun* (HOLOTYPE: NY)
≡ *Biscogniauxia pezizoides* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 2: 398. 1891.
= *Nummularia repanda* (Fr.) Nits., fide Jong & Benjamin, Mycologia 63: 869. 1971.

Nummularia repanda (Fr.) Nits. var. *zonata* Ell. & Ev., Bull. Iowa Univ. Lab. Nat. Hist. 2: 405. 1893.
On dead tree(?), NICARAGUA: Castillo Viejo, Feb 1893, C. A. F. 18, *C. L. Smith* (HOLOTYPE, ISOTYPE: NY) [*C. L. Smith 105* (ISOTYPE: BPI)]

Nummularia rufa Ell. & Ev., Bull. Iowa Univ. Lab. Nat. Hist. 2: 406. 1893.
On bark, NICARAGUA: Ometepe, Winter 1893, *C. L. Smith 54* (HOLOTYPE: NY; ISOTYPE: BPI)
= *Hypoxylon stygium* (Lév.) Sacc., fide Miller, A Monograph of the world species of *Hypoxylon*, p. 92. 1961.

Nummularia subapiculata Ell. & Ev., J. Mycol. 5: 23. 1889.
On bark, KANSAS: Topeka, 1884, *F. W. Cragin 267* (HOLOTYPE: NY)
= *Hypoxylon tinctor* (Berk.) Cke., fide Miller, A Monograph of the world species of *Hypoxylon*, p. 119. 1961.

Nummularia vernicosa Ell. & Ev., Bull. Iowa Univ. Lab. Nat. Hist. 2: 406. 1893.
On dead branch, NICARAGUA: Castillo Viejo, Feb/Mar 1893, C. A. F. 21, *C. L. Smith* (HOLOTYPE: NY) [Smith 117 (ISOTYPE: BPI)]

= *Hypoxylon melanaspis* Mont., fide Miller, A Monograph of the world species of *Hypoxylon*, p. 107. 1961.

Phomatospora wistariae Ell. & Ev., J. Mycol. 8: 68. 1902.
On *Wistaria frutescens*, ALABAMA: *Carver 686* (HOLOTYPE: NY) [22 Sep 1900 (ISOTYPE: FH)]

Podosordaria mexicana Ell. & Holw., Bot. Gaz. 24: 37. 1897.
On cow dung, MEXICO: Cuernavaca, Sep 1896, ex- Herb. Holway, *E. W. Holway* (HOLOTYPE: NY)
= *Xylaria chardoniana* (Toro) Miller, fide Dennis, Kew Bull. 1957: 306. 1957.

Poronia leporina Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1890: 229. 1890.
On rabbit dung, MISSOURI: Emma, Sep 1889, *Demetrio 250* (HOLOTYPE: NY; ISOTYPE: BPI) and N. A. F.: 2354 (ISOTYPES: NY, FH).
≡ *Podosordaria leporina* (Ell. & Ev.) Dennis, Kew Bull. 1957. 306. 1957.
= *Poronia minuta* Petch, fide Krug & Cain, Canad. J. Bot. 52: 596. 1974.

Poronia turbinata Ell. & Ev., Bull. Iowa Univ. Lab. Nat. Hist. 2: 410. 1892.
On bark, NICARAGUA: Castillo Viejo, Feb/Mar 1893, C. A. F. 32, *C. L. Smith* (HOLOTYPE: NY; ISOTYPE: BPI)
≡ *Kretzschmaria turbinata* (Ell. & Ev.) Lloyd, Myc. Writ. 6: 1033. 1921.
≡ *Penzigia turbinata* (Ell. & Ev.) Miller, A Monograph of the world species of *Hypoxylon*, p. 142. 1961.
≡ *Kretzschmaria turbinata* (Ell. & Ev.) P. Martin, J. S. African Bot. 36: 79. 1970.

Rosellinia abietina Fuckel var. *trichota* (Cke. & Ell.) Sacc., see *Sphaeria abietina* Fckl. var. *trichota* Cke. & Ell.

Rosellinia albolanata Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1890: 227. 1890.
On old rails, MISSOURI: Emma, Nov 1889, *Rev. C. H. Demetrio 269* (HOLOTYPE: NY; ISOTYPE: FH)
≡ *Hypoxylon albolanatum* (Ell. & Ev.) P.Martin, J. S. African Bot. 42: 72. 1976.

Rosellinia arctispora (Cke. & Ell.) Sacc., see *Sphaeria arctespora* Cke. & Ell.

Rosellinia bakeri Ell., Torreya 5: 87. 1905.
On *Urera*, NICARAGUA, 1903, *C. F. Baker 3990* (HOLOTYPE: NY) [Chinandega (ISOTYPE: FH)] [Dec 1903 (lit.)].
= *Hypoxylon investiens* (Schw.) Berk. f. *bakeri* (Ell.) Miller, fide Dennis, Kew Bull. 14(3): 450. 1960.

Rosellinia bicolor Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1894: 327. 1894.
On rotten pieces, LOUISIANA: near St. Martinsville, 26 Aug 1889, *A. B. Langlois 2139* (HOLOTYPE: NY)

Rosellinia bigeloviae Ell. & Ev., Amer. Naturalist 31: 341. 1897.
On *Bigelovia graveolens*, COLORADO: *E. Bethel* (HOLOTYPE: NY) [Golden, Dec 1896 (ISOTYPE: BPI)]

Rosellinia caespitosa Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1894: 327. 1894.
On dead hackberry limbs, KANSAS: Rockport, 22 Nov 1893, *E. Bartholomew 1252* (HOLOTYPE: NY)
≡ *Lopadostoma caespitosum* (Ell. & Ev.) P. Martin, J. S. African Bot. 42: 75. 1976.

Rosellinia compressa Ell. & Dearn., Proc. Canad. Inst. n. ser. 1: 89. 1897.
On elm, CANADA: Ontario, near Granton, *J. Dearness 1791* (HOLOTYPE: NY)

Rosellinia confertissima Ell. & Ev., Bull. Torrey Bot. Club 24: 126. 1897.
On rotten wood, OHIO: *Morgan 1172* (ISOTYPE: FH) [*Morgan 1173* (lit.)]

Rosellinia geasteroides Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1895: 415. 1895.
On the base of decaying stem of *Arundinaria*, LOUISIANA: near St. Martinsville, 17 Jul 1895, *A. B. Langlois 2404* (HOLOTYPE: NY; ISOTYPES: BPI, FH)
= *Astrocystis mirabilis* B. & Br., fide Diehl, Mycologia 17: 188. 1925.
≡ *Hypoxylon geasteroides* (Ell. & Ev.) P. Martin, J. S. African Bot. 42: 72. 1976.

Rosellinia gigantea Ell. & Ev., Bull. Iowa Univ. Lab. Nat. Hist. 2: 401. 1893.
On bark, NICARAGUA: Castillo Viejo, Winter 1893, *C. L. Smith 34* (HOLOTYPE: NY; ISOTYPE: FH), C. A. F. 10 (ISOTYPES: NY, BPI)
≡ *Hypoxylon giganteum* (Ell. & Ev.) P. Martin, J. S. African Bot. 42: 72. 1976.

Rosellinia gigaspora Ell. & Ev., Bull. Iowa Univ. Lab. Nat. Hist. 2: 401. 1893.
On bamboo cane(?), NICARAGUA: Castillo Viejo, Feb/Mar 1893, *C. L. Smith* (HOLOTYPE: NY)
≡ *Hypoxylon gigasporum* (Ell. & Ev.) P. Martin, J. S. African Bot. 42: 72. 1976.

Rosellinia glandiformis Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1890: 227. 1890.
On live oak stump (*Quercus*), LOUISIANA: St. Martinsville, Feb 1889, *A. B. Langlois 1768* (HOLOTYPE: NY; ISOTYPE: FH)
≡ *Hypoxylon glandiforme* (Ell. & Ev.) P. Martin, J. S. African Bot. 34: 190. 1968.

Rosellinia hystrix Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1893: 444. 1894.
On old hickory nuts lying on the ground, NEW JERSEY: Newfield, 18 May 1893, *J. B. Ellis s. n.* (HOLOTYPE: NY; ISOTYPE: FH)

Rosellinia kellermannii Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1890: 227. 1890.
On very rotten wood of *Negundo aceroides*, KANSAS: Manhattan, 24 Mar 1889, *# 1378* (HOLOTYPE: NY) [*Kell. & Swingle 1378* (ISOTYPE: FH)]
≡ *Coniochaeta kellermannii* (Ell. & Ev.) Munk, Dansk Bot. Ark. 15(2): 54. 1953.

Rosellinia langloisii Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1890: 228. 1890.
On much rotten vine of *Vitis vulpina*, LOUISIANA: St. Martinsville, 26 Mar 1889, *A. B. Langlois 1679* (HOLOTYPE: NY; ISOTYPES: BPI, FH). [*A. B. Langlois 1779* (lit.)]
≡ *Hypoxylon langloisii* (Ell. & Ev.) P. Martin, J. S. African Bot. 42: 73. 1976.

Rosellinia limoniispora Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1894: 326. 1894.
On dead limbs of *Fraxinus*, KANSAS: Rockport, 4 Aug 1894, *Bartholomew 1545* (HOLOTYPE: NY)
≡ *Hypoxylon limoniisporum* (Ell. & Ev.) P. Martin, J. S. African Bot. 42: 73. 1976.

Rosellinia macouniana Ell. & Ev., Bull. Torrey Bot. Club 11: 74. 1887.
On rotten wood, CANADA: Ottawa, Oct 1883, *Macoun 253* [lit.].
≡ *Byssosphaeria macouniana* (Ell. & Ev.) Cke., Grevillea 15: 122, 1887.

Rosellinia macra Ell. & Ev., Bull. Torrey Bot. Club 24: 126. 1897.
On leaves of monocot plant, FLORIDA, 1895, *A. P. Morgan 1134* (HOLOTYPE: NY) [On leaf of (*Sabal*?) ISOTYPE: FH]

Rosellinia megaloecia Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1893. 128. 1893.

On *Salix*, MONTANA: One mile west of Sheridan, Mill Creek, 20 Jan 1892, *W. M. Fitch 9* (HOLOTYPE: NY)

Rosellinia melaleuca Ell. & Ev., Bull. Iowa Univ. Lab. Nat. Hist. 2: 402. 1893.
On wood, NICARAGUA: Ometepe, Jan 1893, *B. Shimek*, C. A. F. 11 (HOLOTYPE: NY; ISOTYPE: BPI).

Rosellinia muriculata Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1895: 416. 1895.
On fibrous cottonwood bark (*Populus monilifera*), KANSAS: Rooks Co., 21 Dec 1894, *E. Bartholomew 1613* (HOLOTYPE: NY; ISOTYPES: BPI, FH)

Rosellinia obliquata (Somm.) Sacc. var. *americana* Ell. & Ev., N. Amer. Pyrenomyc. p. 169. 1892.
On dead cones of *Pinus ponderosa* var. *scopulorum*, MONTANA: Belt Mts., Sep 1889, *F. W. Anderson 613* (HOLOTYPE: NY; ISOTYPES: NY, BPI)

Rosellinia ostiolata Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1894: 327. 1894.
On bark of *Ulmus americana*, KANSAS: Rockport, 2 Apr 1894, *E. Bartholomew 1429* (HOLOTYPE: NY; ISOTYPE: FH)

Rosellinia ovalis (Ell.) Sacc., see *Sphaeria ovalis* Ell.

Rosellinia parasitica Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1890: 227. 1890.
On dead limbs of *Symphoricarpus occidentalis*, MONTANA: Helena, *Rev. F. D. Kelsey*, N. A. F. 2: 2351 (ISOTYPES: NY, BPI, FH) [Elisens (1985) mentioned a holotype in NY, but it was not found].

Rosellinia pinicola Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1894: 327. 1894.
On weathered pine board, KANSAS: Rockport, 15 Feb 1894, *E. Bartholomew 379* (HOLOTYPE: NY)

Rosellinia poliosa Ell. & Ev., Bull. Torrey Bot. Club 22: 439. 1895.
On decaying post, MEXICO: Monterey, Jun 1895, *Dr. B. F. G. Egeling 50* (HOLOTYPE: NY)
≡ *Hypoxylon poliosum* (Ell. & Ev.) P. Martin, J. S. African Bot. 42: 73. 1976.

Rosellinia pulcherrima Ell. & Ev., Erythea 1: 197. 1893.
On detached fir bark partly covered with soil, WASHINGTON: Seattle, 18 Sep 1892, *A. M. Parker 160* (HOLOTYPE: NY; ISOTYPE: FH)
= *Hypoxylon pulchrum* P. Martin, J. S. African Bot. 42: 82. 1976.

Rosellinia subcompressa Ell. & Ev., Bull. Torrey Bot. Club 24: 277. 1897.
On dead cottonwood twigs, SOUTH DAKOTA: Aberdeen, Apr 1897, *D. Griffiths 7* (HOLOTYPE: NY; ISOTYPE: FH) [On *Populus deltoidea* Marsh. (ISOTYPE: BPI)]

Rosellinia thelena (Fr.) Rabh. var. *terrestris* Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1895: 22. 1895.
On ground, NEW YORK, (*Schw.*) [lit.].

Rosellinia trichota (Cke. & Ell.) Ell. & Ev., see *Sphaeria abietina* (Fckl.) var. *trichota* Cke. & Ell.

Rosellinia xylarispora (Cke. & Ell.) Sacc., see *Sphaeria xylariaespora* Cke. & Ell.

Sphaeria abietina Fuckel var. *trichota* Cke. & Ell., Grevillea 6: 13. 1877.
On Jersey pine lumber lying on the ground, NEW JERSEY: Gloucester Co., Newfield, 27 Apr 1876, *Cooke 2401.* On Jersey pine pole in the grape trellis, NEW JERSEY, Mar 1877. On smooth cut surface of a white cedar stump, NEW JERSEY: Gloucester Co., Newfield, Apr 1877 (SYNTYPES: NY)

≡ *Rosellinia abietina* Fuckel var. *trichota* (Cke. & Ell.) Sacc., Syll. Fung. 1: 272. 1882.
= *Rosellinia trichota* (Cke. & Ell.) Ell. & Ev., N. Amer. Pyrenomyc. p. 172. 1892.

Sphaeria antiqua Ell. & Ev., Bull. Torrey Bot. Club 10: 90. 1883.
On loose bark of grape-vines, NEW JERSEY: Newfield, May 1883, *J. B Ellis s. n*. (ISOTYPE: FH)
≡ *Thyridium antiquum* (Ell. & Ev.) Berl. & Vogl., Syll. Fung. Addit. 1-4: 185. 1886.
≡ *Pleospora antiqua* (Ell. & Ev.) Ell. & Ev., Cat. Pl. N. J. p. 523. 1890.
≡ *Xylosphaeria antiqua* (Ell. & Ev.) Petr., Sydowia 4: 18. 1950.
≡ *Mycothyridium antiquum* (Ell. & Ev.) Petr., Sydowia 15: 289. 1961.

Sphaeria arctespora Cke. & Ell., Grevillea 5: 93. 1877.
On *Andromeda* (inside the bark), NEW JERSEY: Vineland, 12 Nov 1876, *J. B. Ellis s. n.*, ex Herb. W. G. Farlow, 'type gathering' (ISOTYPES: NY, FH, BPI)
≡ *Rosellinia arctispora* (Cke. & Ell.) Sacc., Syll. Fung. 1: 268. 1882.

Sphaeria atrograna Cke. & Ell., Grevillea 8: 15. 1879.
On rotten *Liquidambar*, NEW JERSEY: Malaga, 14 Sep 1878, *# 3179* (ISOTYPE: NY)
≡ *Amphisphaeria atrograna* (Cke. & Ell.) Sacc., Syll. Fung. 1: 722. 1882.
≡ *Melanomma atrogranum* (Cke. & Ell.) Cke., Grevillea 16: 52. 1887.
≡ *Gibbera atrograna* (Cke. & Ell.) Sivanesan, Trans. Br. Mycol. Soc. 65: 396. 1975.

Sphaeria bisphaerica Cke. & Ell., Grevillea 7: 41. 1878.
On an old apple tree limb lying on the ground, NEW JERSEY: Newfield, 10 Jun 1878, *# 3068*, "no duplicate". (?HOLOTYPE: NY)
≡ *Amphisphaeria bisphaerica* (Cke. & Ell.) Sacc., Syll. Fung. 1: 721. 1882.

Sphaeria fissicula Cke. & Ell., Grevillea 6: 94. 1878.
On *Rosa*, NEW JERSEY: Newfield, *# 2683, J. B. Ellis* (lit.)
≡ *Cryptosphaeria fissicola* (Cke. & Ell.) Sacc., Syll. Fung. 1: 185. 1882.
≡ *Engizostoma fissicola* (Cke. & Ell.) Kuntze, Rev. Gen. Pl. 3(2): 474. 1898.

Sphaeria leucobasis Ell. & G. Martin, Amer. Naturalist 16: 809. 1882.
On petioles of *Sabal serrulata*, FLORIDA, Winter 1882, *Dr. G. Martin* (HOLOTYPE: NY) [Green Cove Springs (ISOTYPE: BPI)] N. A. F.: 1199 (ISOTYPES: NY, BPI, FH)
≡ *Anthostomella leucobasis* Ell. & G. Mart., N. Amer. Pyrenomyc. p. 418. 1892.

Sphaeria mortuosa Ell., Bull. Torrey Bot. Club 9: 73. 1882.
On *Eupatorium purpureum*, on old *Polygonum*, on old half decayed *Andropogon*, NEW JERSEY: Gloucester Co., Newfield, Oct 1879, Apr 1880, 23 Sep 1879, respectively (SYNTYPES: NY) N. A. F.: 897 (ISOSYNTYPE: NY, FH, BPI)
≡ *Anthostoma mortuosum* (Ell.) Sacc., Syll. Fung. 9: 519. 1891.
≡ *Xylosphaeria mortuosa* (Ell.) Cke., Grevillea 17: 86. 1889.
= *Anthostomella xylostei* (Sacc.) P. Martin, J. S. African Bot. 35: 404. 1969.
= *Anthostomella tomicoides* Sacc., fide Francis, Mycol. Pap. 139: 52. 1975.

Sphaeria oronoensis Ell. & Ev., J. Mycol. 3: 117. 1887.
On rotten wood of some coniferous tree, MAINE: Orono, Nov 1886, *F. L. Harvey 57* (HOLOTYPE: NY; ISOTYPE: BPI)
≡ *Amphisphaeria oronoensis* (Ell. & Ev.) Sacc., Syll. Fung. 9: 746. 1891.

Sphaeria ovalis Ell., Bull. Torrey Bot. Club 8: 125. 1881.
On sage brush, UTAH: Pleasant Valley, 1881, *S. J. Harkness* (HOLOTYPE: NY), and N. A. F.: 896 (ISOTYPE: NY, BPI, FH)
≡ *Rosellinia ovalis* (Ell.) Sacc., Syll. Fung. 1: 269. 1882.
= *Rosellinia pulveracea* (Ehr.) Fckl., fide Riley, Torreya 1: 22. 1901.

Sphaeria pholidigena Ell., Bull. Torrey Bot. Club 10: 54. 1883.

On cones of red pine, UTAH: Pleasant Valley, Feb 1882, *S. J. Harkness 90* (HOLOTYPE: NY) and N. A. F. 2: 1664 (ISOTYPES: NY, FH)

≡ *Anthostomella pholidigena* (Ell.) Berl. & Vogl., Syll. Fung. Addit. 1-4: 44. 1886.
≡ *Anthostoma pholidigena* (Ell.) Cke., Grevillea 17: 90. 1889.
= *Lopadostoma conorum* (Fckl.) P. Martin, J. S. African Bot. 35: 400. 1969.

Sphaeria picacea Cke. & Ell., Grevillea 7: 9. 1878.

On decorticated *Vaccinium* and *Acer*, NEW JERSEY: Newfield, *J. B. Ellis s. n.* (ISOTYPE: NY), and N. A. F.: 183 (ISOTYPE: NY, FH, BPI)

≡ *Anthostomella picacea* (Cke. & Ell.) Sacc., Syll. Fung. 1: 293. 1882.
≡ *Anthostoma picaceum* (Cke. & Ell.) Ell. & Ev., N. Amer. Pyrenomyc. p. 578. 1892.
= *Anthostomella inconspicua* P. Martin, J. S. African Bot. 35: 398. 1969.

Sphaeria sabalensioides Ell. & G. Martin, Amer. Naturalist 16: 810. 1892.

On *Sabal*, FLORIDA: Green Cove Springs, Winter 1881-1882, *Dr. Martin* (HOLOTYPE: NY) [On *Sabal serrulata* (lit.)]

≡ *Anthostomella sabalensioides* (Ell. & G. Martin) Sacc., Syll. Fung. 2: xiii. 1883.
≡ *Entosordaria sabalensioides* (Ell. & G. Martin) Hoehn., Sitzb. Akad. Wien 192: 166. 1920.

Sphaeria xylariaespora Cke. & Ell., Grevillea 6: 94. 1877.

On decorticated *Andromeda*, NEW JERSEY: Newfield, *J. B. Ellis 2800* (lit.).

≡ *Rosellinia xylarispora* (Cke. & Ell.) Sacc., Syll. Fung. 1: 272. 1882.
≡ *Coniochaeta xylarispora* (Cke. & Ell.) Cke., Grevillea 16: 16. 1887.

Thyridium americanum Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1893. 139. 1893.

On *Xanthoxylum americanum* (prickly ash), CANADA: London, Apr 1892, *# 1780* [*Dearness* (lit.)] (HOLOTYPE: NY)

≡ *Xylosphaeria americana* (Ell. & Ev.) Petrak, Sydowia 4: 18. 1950.
≡ *Mycothyridium americanum* (Ell. & Ev.) Petrak, Sydowia 15: 288. 1961 (1962).

Thyridium antiquum (Ell. & Ev.) Berl. & Vogl., see *Sphaeria antiqua* Ell. & Ev.

Thyridium canadense Ell. & Ev., N. Amer. Pyrenomyc. p. 416. 1892.

On old logs, CANADA: Ontario, Lake Nigiron, 26 Jun 1887, [*Macoun* (lit.)] (HOLOTYPE: NY)

≡ *Thyridella canadensis* (Ell. & Ev.) Sacc., Syll. Fung. 11: 351. 1895.
≡ *Peltosphaeria canadensis* (Ell. & Ev.) Berl, Icon. Fung. 2: 110. 1897.
≡ *Peltosphaeria canadensis* (Ell. & Ev.) Riedl, Sydowia 15: 304. 1961 (1962).

Thyridium pallidum Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1895: 424. 1895.

On dead *Rhus glabra*, KANSAS: Rooks Co., May 1895, *Bartholomew 1711* (HOLOTYPE: NY) [25 May 1895 (ISOTYPE: FH)]

≡ *Xylosphaeria pallida* (Ell. & Ev.) Petrak, Sydowia 4: 19. 1950.
≡ *Mycothyridium pallidum* (Ell. & Ev.) Petrak, Sydowia 15: 289. 1961 (1962).

Thyridium stilbostomum Ell. & Ev., J. Mycol. 9: 223. 1903.

On old maple limbs, CANADA: Ontario, 21 Oct 1903 [*Dearness 3001* (lit.)] (HOLOTYPE: NY; ISOTYPE: FH)

≡ *Xylosphaeria stilbostoma* (Ell. & Ev.) Petrak, Sydowia 4: 19. 1950.
≡ *Mycothyridium stilbostomum* (Ell. & Ev.) Petrak, Sydowia 15: 290. 1961 (1962).

Thyridium syringae Ell. & Ev., Proc. Acad. Nat. Sci. Philadelphia 1893: 139. 1893.

On dead limbs of lilac (*Syringa*), CANADA: London, Mar 1892, *Dearness 1654* (HOLOTYPE: NY)

≡ *Xylosphaeria syringae* (Ell. & Ev.) Petrak, Sydowia 4: 19. 1950.

≡ *Mycothyridium syringae* (Ell. & Ev.) Petrak, Sydowia 15: 290. 1961 (1962).

Thyridium vitis Ell. & Ev., Bull. Torrey Bot. Club 27: 53. 1900.
On dead shoots of *Vitis riparia*, KANSAS: Rooks Co., *Bartholomew* [lit.]
≡ *Xylosphaeria vitis* (Ell. & Ev.) Petr., Sydowia 4: 20. 1950.
≡ *Mycothyridium vitis* (Ell. & Ev.) Petr., Sydowia 15: 290. 1961 (1962).

Valsa canodisca Ell. & Holw., Proc. Acad. Nat. Sci. Philadelphia 1890: 223. 1890.
On *Salix*, IOWA: Decorah, 9 May 1886, *E. W. Holway* (HOLOTYPE: NY)
≡ *Eutypella canodisca* (Ell. & Holw.) Sacc., Syll. Fung. 9: 463. 1891.
≡ *Engizostoma canodisca* (Ell. & Holw.) Kuntze, Rev. Gen. Pl. 3(2): 473. 1898.
= *Diatrype albopruinosa* (Schwein.) Cke. var. *salicina* Rehm, fide Rappaz, Mycologia Helvetica 2: 503. 1987.

Valsa capillata Ell. & Ev., J. Mycol. 4: 74. 1888.
On decaying pieces laying in a damp place, LOUISIANA: St. Martinsville, 28 May 1888, *A. B. Langlois 1254* (HOLOTYPE: NY; ISOTYPE: FH).
≡ *Eutypella capillata* (Ell. & Ev.) Sacc., Syll. Fung. 9: 462. 1891
≡ *Engizostoma capillatum* (Ell. & Ev.) Kuntze, Rev. Gen. Pl. 3(2): 472. 1898.
≡ *Peroneutypella capillata* (Ell. & Ev.) Berl., Icon. Fung. 3: 84. 1902.
= *Eutypella scoparia* (Schwein. : Fr.) Ell. & Ev., fide Rappaz, Mycologia Helvetica 2: 537. 1987.

Valsa deusta Ell. & Ev., J. Mycol. 4: 74, 1888.
On a piece of rotten *Carya*, LOUISIANA: St. Martinsville, 16 Jun 1888, *Langlois 1334* (HOLOTYPE: NY; ISOTYPE: FH) [*On Carya olivaeformis* (ISOTYPE: BPI)]
≡ *Eutypella deusta* (Ell. & Ev.) Ell. & Ev., N. Amer. Pyrenomyc., p. 489. 1892.
≡ *Engizostoma deustum* (Ell. & Ev.) Kuntze Rev. Gen. Pl. 3(2): 473. 1898.
= *Eutypella scoparia* (Schwein. : Fr.) Ell. & Ev., fide Rappaz, Mycologia Helvetica 2: 537. 1987.

Valsa juglandina Cke. & Ell., Grevillea 5: 92. 1877.
On *Juglans regia*, # 2421, NEW JERSEY: Newfield, Oct 1876, *J. B. Ellis* (ISOTYPE: NY).
≡ *Eutypella juglandina* (Cke. & Ell.) Sacc., Syll. Fung. 1: 154. 1882.
≡ *Eutypella juglandicola* (Schw.) Ell. & Ev. var. *juglandina* (Cke. & Ell.) Ell. & Ev., N. Amer. Pyrenomyc. p. 495. 1892.
= *Engizostoma ellisii* Kuntze, Rev. Gen. Pl. 3(2): 472. 1898.

Valsa lutescens Ell., Bull. Torrey Bot. Club 9: 111. 1882.
On dead limbs of *Quercus coccinea*, NEW JERSEY: Newfield, Feb 1881, N. A. F.: 876, as cited in the original description. (ISOTYPE: NY, FH)
≡ *Eutypella lutescens* (Ell.) Sacc., Syll. Fung. 2: vii. 1883.
≡ *Engizostoma lutescens* (Ell.) Kuntze, Rev. Gen. Pl. 3(2): 474. 1898.

Valsa maclurae Cke. & Ell., Grevillea 8: 14. 1879.
On *Maclura*, NEW JERSEY: Newfield, Sep 1878, *J. B. Ellis 3104* (ISOTYPE: NY) N. A. F.: 873 (ISOTYPES: NY, BPI, FH)
≡ *Eutypella maclurae* (Cke. & Ell.) Ell. & Ev., N. Amer. Pyrenomyc. p. 496. 1892.
≡ *Cytospora maclurae* Ell. & Barth., Erythea 5: 48. 1897.
≡ *Enzigostoma maclurae* (Cke. & Ell.) Kuntze, Rev. Gen. Pl. 3(2): 474. 1898.

Valsa microcarpa Ell. & Ev., J. Mycol. 4: 122. 1888.
On decayed pieces of peach tree, LOUISIANA: St. Martinsville, 18 Aug 1888, *A. B. Langlois 1481* (HOLOTYPE: NY; ISOTYPES: BPI,FH)
≡ *Eutypella microcarpa* (Ell. & Ev.) Sacc., Syll. Fung. 9: 462. 1891
≡ *Peroneutypella microcarpa* (Ell. & Ev.) Berl, Icon. Fung. 3: 83. 1902.
= *Eutypella scoparia* (Schwein. : Fr.) Ell. & Ev., fide Rappaz, Mycologia Helvetica 2: 538. 1987.

Valsa rugiella Cke. & Ell., Grevillea 5: 92. 1877.

On maple [On *Acer rubrum* (lit.)], NEW JERSEY: Newfield, Mar 1876, *J. B. Ellis s. n.* (ISOTYPE: NY) N. A. F.: 176 (possible, ISOTYPE: NY, FH)

≡ *Eutypella rugiella* (Cke. & Ell.) Sacc., Syll. Fung. 1: 156. 1882.

≡ *Engizostoma rugiellum* (Cke. & Ell.) Kuntze, fide Rev. Gen. Pl. 3(2): 475. 1898.

Valsa venusta Ell., Bull. Torrey Bot. Club 9: 112. 1882.

On *Robinia pseudacacia*, NEW JERSEY: Gloucester Co., Newfield, Jun 1881 (HOLOTYPE: NY) N. A. F.: 875, as cited in the original description (ISOTYPE: NY, FH)

≡ *Eutypella venusta* (Ell.) Sacc., Syll. Fung. 2: vii. 1883.

≡ *Engizostoma venusta* (Ell.) Kuntze, Rev. Gen. Pl. 3(2): 475. 1898.

Xylaria cylindrica Ell. & Ev., Bull. Iowa Univ. Lab. Nat. Hist. 2: 414. 1892.

On bark, NICARAGUA: Castillo Viejo and Ometepe, Winter 1893, *B. Shimek & C. L. Smith 12* (HOLOTYPE: NY; ISOTYPE: FH)

= *Xylaria teres* Sacc., Syll. Fung. 11: 284. 1895.

= *Xylaria multiplex* (Kunze) Dennis, Bull. Jard. Bot. Etat 31: 125. 1961.

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NOTES ON TROPICAL AND WARM TEMPERATE BASIDIOMYCETES

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SUMMARY. Eight noteworthy fungi in seven genera from the tropical and warm temperate zones are discussed and illustrated. Four, *Deflexula subsimplex, Lachnocladium schweinfurthiana*, and *Ramaria cyanocephala* and *R. zippelii* are clavarioid; one, *Echinochaete brachyporus* is poroid; one *Gyrodontium versicolor* is hydnoid; one, *Gomphus cavipes* is cantharelloid; and one, *Thelephora aurantiotincta* is thelephoroid. All are either rarely reported, or occur outside their known ranges, or they are poorly understood, or a combination of these.

Key Words: Deflexula, Lachnocladium, Ramaria, Echinochaete, Gyrodontium, Gomphus, Thelephora

Deflexula subsimplex (P.Henn.) Corner, Ann. Bot. n.s. **16**: 279. 1952. Fig. A 1. Plate 1.

Basidiocarps springing from small inconspicuous mycelial discs 2-3mm wide,consisting of small and large clusters of unbranched pendent spines - 1cm; width of spines ca. 300 µm, whitish buff when fresh, dark flesh color when dry.

On corticated wood of an undet. hardwood (Guzman 24483 in ENCB & NO); on tree bark (C. Ovrebo 2083 & A. Meier in NO). The former collection is from Mexico; the latter from Costa Rica.

Spores 10-11 x 5.4-6.3 µm, amygdaliform, with slightly thickened walls, a prominent apiculus and often a large guttule, angled and light yellow in drying, IKI-; basidia not observed; basidioles ca. 23-30 x 6-9 µm, prominently guttulate, stoutly clavate or cylindrical with swollen apices; hymenium not developed for ca. 300 µm from the tip of spine on one side and ca. 900 µm from the tip on the other; dimitic with skeletal hyphae; subhymenium of generative hyphae ca. 4 µm in diam arranged into a pseudoparenchyma; cystidia and other sterile organelles absent; generative hyphae of context 4-6 µm in diam, with very long cells, with clamps and often secondary simple septa; skeletal hyphae unstained in phloxine, with slightly thickened walls, prominent in context.

This fungus was reported by Corner (1967) as *D. nivea* (Pat.) Corner from Guadeloupe. Later, Corner (1970) synonymized that taxon with *D. subsimplex* and reported collections from Costa Rica, Panama, Brazil, Bolivia (our spore sizes reported here are close to those reported by Corner for Singer's collection from this region), Argentina, India, Borneo, and Solomon Islands. Although this taxon is seldom listed in tropical collections, it appears to be a typical member of the pantropic mycoflora.

Echinochaete brachyporus (Mont.) Ryv., Bull. Jard. Bot. Nat. Belg. **48**:101. 1978. Fig. A 2-7.

Basidiocarp laterally stipitate, somewhat spongy coriaceous; pileus 4.6 cm long x 6.5 cm wide, undulate to shallow lobed, stipe junction clearly marked by narrow ridge on upper surface; abhymenial surface minutely tomentose, orange yellow with vinaceous tints, especially toward margin, extreme edge may be deep wine red; adhymenial surface near pale orange yellow but reddish black at pore edges (bruising?); pores shallow, 2-3/mm in well-developed areas, some appear pulled apart in drying, other small areas devoid of pores; pores irregularly polygonal and with brown protruding setoids (under lens), decurrent over ca. one-half stipe surface.

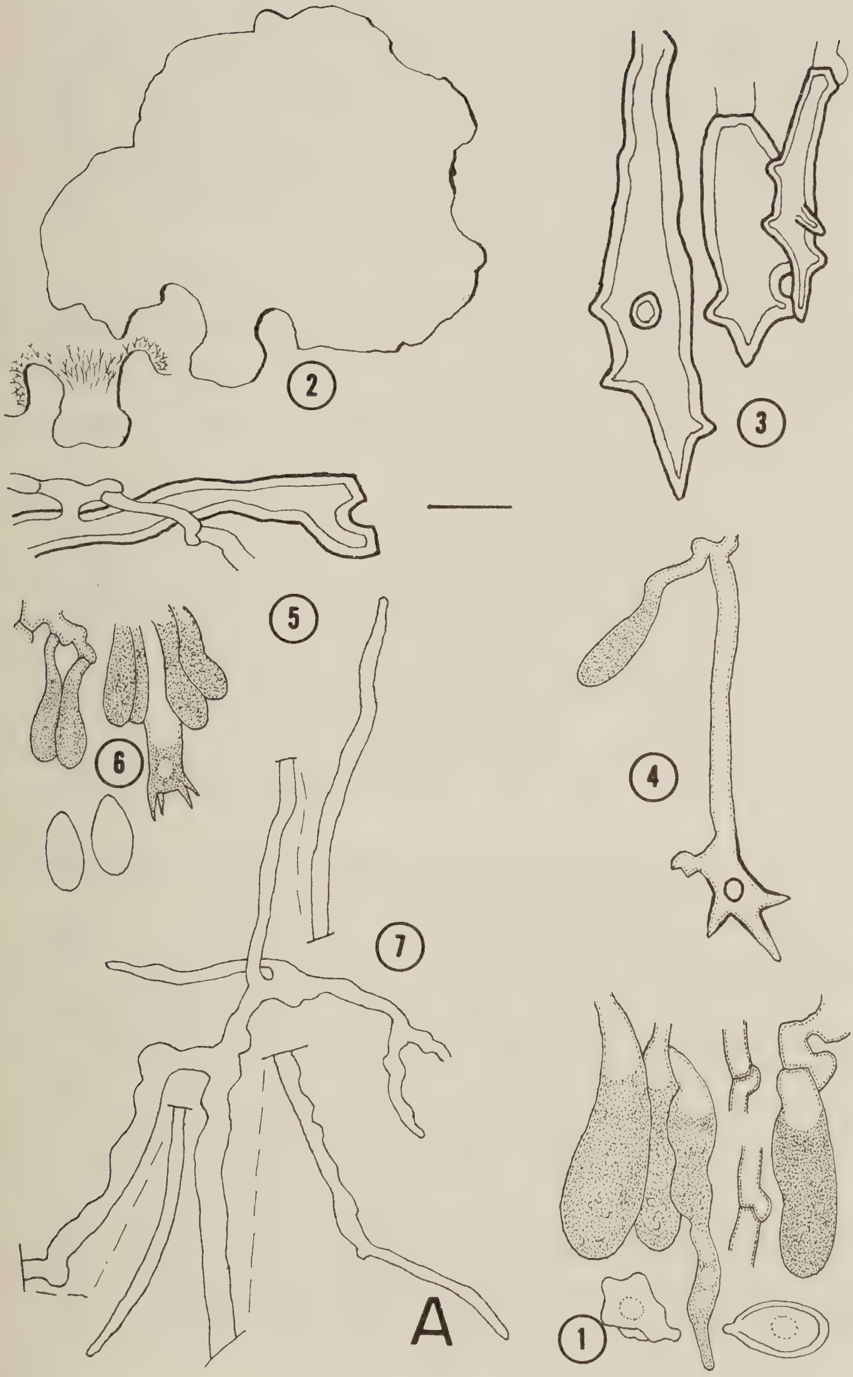
Stipe 0.8 cm long from ridge at pileus junction to base x 0.8 cm wide, with traces of pore outlines caused by minutely fimbriate ridges which darken with KOH (setoids).

Lignicolous. Mexico: Coba, Quintana Roo, 12 May 1986, leg. A.L.W. s.n. (NO).

Spores 10-14 x 3.5-6.5 µm ($\bar{x}$ 11= 12.7 x 4.6 µm; e=2.7), cylindrical to cylindrical-allantoid, colorless, often with 1-several large guttules and many smaller ones, IKI-, acyanophilous.

In section pileus with cuticle and context; adhymenially the context extends into trama with only slight change in hyphal organization; cuticle 27-90 µm thick, of densely compact basically parallel hyphae, with an occasional hyphal end projecting abhymenially; context of interwoven hyphae often more compact in trama; generative hyphae in ± parallel bundles; subhymenium inconspicuous. Hyphal structure dimitic with binding hyphae;

FIG. A. 1. *Deflexula subsimplex*. Hymenial detail, clamped generative hyphae, and spores. 2-7. *Echinochaete brachyporus*. 2. Habit sketch x 0.8. 3. Mature setoid elements from hymenium. 4. Young setoid element. 5. connection between wide thick-walled generative hypha and narrow thin-walled generative hypha. 6. Hymenial detail and spores. 7. Binding hypha. Bar= 10µm.


A

generative hyphae thin-walled clamped, ca. 4.5 µm in diam, some -12 µm in diam, staining evenly in phloxine and usually with long cells (vascular hyphae ?); binding hyphae unstained in phloxine, walls -1 µm thick, main body 6-7 µm in diam, sparingly branched along its length, with 1-few tapering branches at tip, these with narrow lumen, 2-3 µm in diam, -400 µm between a branch and its tip. Hymenium of basidioles, basidia, and spinulose heavily pigmented setoids; setoids metamorphosed basidioles, basidia ca. 7 µm in diam, clavate, 4-sterigmate.

This taxon is pantropical. It has been reported from Cayenne in South America (Saccardo, 1888) and from Uganda, Tanzania, Malawi, Kenya, and Burundi. It would be interesting to know the forest type of those collections. The Quintana Roo collection was made in a Semi-deciduous Forest (Rzedowski, 1986) on limestone soil. The forest is subject to an annual dry season of some severity.

Gomphus cavipes Corner, Nov. Hedw. **18**: 808. 1969. Fig. B 1-4. Plate 1.

Basidiocarps fleshy-coriaceous, petalloid, flabellate, ochraceous cinnamon, some with recurved margins giving an infundibuliform (pseudoinfundibuliform) appearance, 5-8 cm tall KOH-, greenish gray in ferric sulfate solution; abhymenial surface smooth, glabrous, opaque or watery translucent, light ochraceous, not discoloring; adhymenial surface smooth, dull, pale, not discoloring; context 3-4 mm thick midway from pileus margin to stipe; stipe hollow, rounded to somewhat flattened, concolorous except for white basal mycelium, sometimes 2-3 stipes joined at base.

On soil. Colombia: Mpio. Guatape, Dpto. Antioquia. In premontane rainforest, ca. 1850 m alt. leg. C. Ovrebo 2520 (NY, HUA).

Spores 8.5-16.2 x 4.5-7.2 µm ($\bar{x}$ 30= 9.8 x 5.9 µm; e=1.6), oval to cylindrical, light ochraceous, ochraceous buff in deposit, rugose, thick-walled, amygdaliform, cyanophilous, apiculus 1.5-2 µm long.

Basidia ca. 56 x 7-9 µm (base obs. in one), clamped, cylindrical-clavate or clavate with long slender stalks 3-4 µm in diam, enlarging toward apex, 4-sterigmate, each sterigma ca. 4.5 µm long, straight; paraphysoid hyphae 3-4 µm in diam, among basidia and basidioles; clamped generative hyphae 3-9.4 µm in diam, thin-walled, some giving rise to numerous, unbranched, 1-2x coiled oleiferous hyphae 3-9.5 µm in diam, found only in context.

This is second report of *G. cavipes* and extends its range slightly from Trinidad to Colombia. It differs in minor ways from the holotype. The adhymenial surface is smooth but in some areas it drys into irregular blocks which exposes the context. The holotype shows a number of shallow folds and little or no cracking. The collection was ochraceous cinnamon when fresh; the holotype white. There was no color change when handled, but (and this was inadvertently omitted when the holotype was sent to Professor Corner) notes accompanying a second Trinidad specimen (ALW 1756) refer to a color change to vinaceous when bruised. More seriously, the Colombian material lacks the smaller lateral pilei of the holotype when dry and appears pleuropodial rather than mesopodial. In some respects this material resembles the description of *G. subclavaeformis* (Berk.)Corner (1970). However, the lack of gloeocystidial endings in the hymenium and its hollow stipe firmly places this fungus in *G. cavipes*. The apparent pleuropodial condition in its dried state may be explained in part by the tendency of the hollow base to collapse when drying and in part to the evident flattening and coalescing of the distal parts into a dorsiventral pileus. The surfaces surrounding the hollow stem tend to flatten as they grow distally. As these surfaces come together, the narrowing hollow is filled with loosely interweaving vegetative and oleiferous hyphae surrounded by densely compact longitudinally parallel hyphae, also with oleiferous elements.. Still more distally the hollow disappears and the two surfaces coalesce. In section this latter region appears as a typical dorsiventral pileus. Hymenial development is unilateral even before coalescence into a flattened pileus. But before these features can be determined accurately, freshly collected material preserved in a weak fixative such as recommended by Corner (1967) must be available.

Gyrodontium versicolor (Berk. & Br.) Maas G., Persoonia **3**(2): 190. 1964. Fig. C 1. Plate 1.

Basidiocarp sessile-pileate; pileus 35-45 mm long x 50-75 mm wide, ± reniform; abhymenial surface matted-cottony, slightly moist, light yellow when young, becoming darker ochraceous brown, finally brown, often darker brown toward base of pileus, not discoloring; context spongy, 3 mm thick, light greenish yellow; adhymenial surface with terete, obtuse, yellowish green spines 2-3 mm long toward the base, shorter and smaller toward the margin, ca. 2/mm; margin with whitish sterile zone 1-2 mm wide.

Costa Rica: La Selva Biological Station, on base of dead tree in lowland tropical rainforest, 2 Jul 1986, leg. C. Ovrebo 2084; l.c., on same substrate, leg. 7 Jul 1986, C. Ovrebo 2126.

Spores 4-5.4 x 2.7-3.1 µm ($\bar{x}$ 10= 4.0 x 2.8 µm; e= 1.4), oval, brown, thick-walled, with prominent apiculus, print dark olivaceous green whenfresh, olive brown when dry.

With clampless generative hyphae 2-6 µm in diam, thin-or slightly thick-walled, pale yellowish; context of compact anastomosing fibrils of hyphae separated by loosely arranged, branching individual hyphae, more compact adhymenially where densely interwoven hyphae grow into spines bearing the hymenium; abhymenial surface covered by amorphous material with numerous embedded spores often mixed with loosely arranged hyphae; basidia and basidioles completely covering the spine surface; basidia 20-24 x 3.6-5.4 µm with 4 short needle-like sterigmata each ca. 2 µm long.

Maas Geesteranus (1964) has painstakingly untangled the synonymy of this taxon, which he considers monotypic. Specimens of *G. versicolor* are known from Africa, Australia, the Bonin Islands, and Ceylon. It is listed in Hawksworth, et al (1983) as widespread. To our knowledge this is the first report of this species from the New World.

Gyrodontium spores are typically coniophoroid. In any single mount they are erratically cyanophilous. The positively cyanophilous spores are the younger ones. The fruitbody is often spotted deep brown. This is caused by heavy deposits of spores.

Lachnocladium schweinfurthiana P. Henn., Bot. Jahrb. **17**:21. 1893. Fig. B. 5-7.

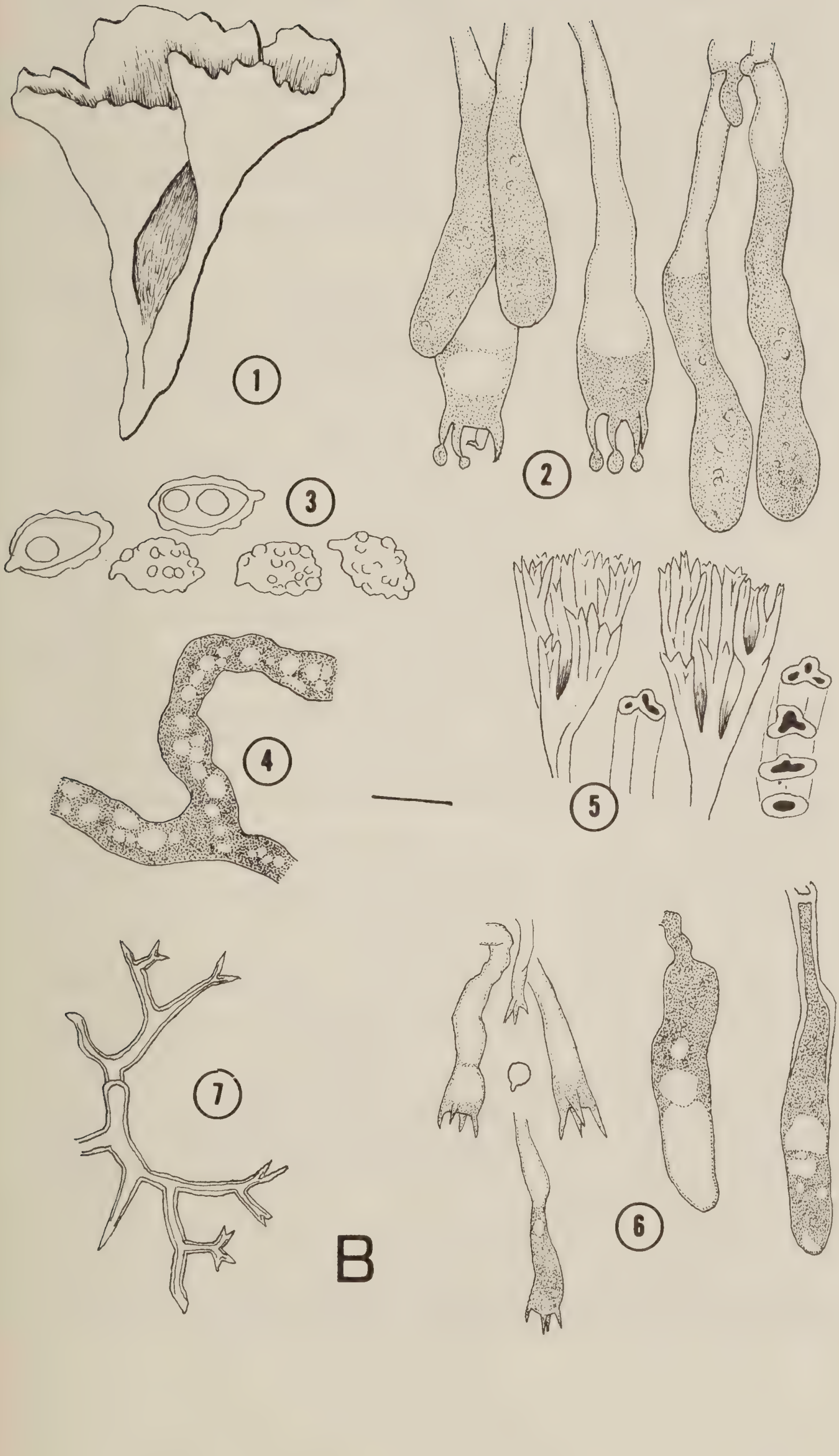
Basidiocarps densely caespitose, -4.5 cm tall, arising from ochraceous rhizomorphic strands and white mycelium incorporating debris; much branched dichotomously and polychotomously almost to the base; anastomosing freely by outgrowths of cortical hyphae into a compact mass, apices often suppressed and cristate.

U.S.A.: Florida, in humus closely associated with rotting hardwood stump and grass rhizomes, Univ. of Florida campus near Florida State Museum, Gainesville, 11 Aug 1985, leg ALW s.n. (NO).

Spores 3.5-5.0 x 2.5-4.5 µm ($\bar{x}$10=3.7 x 3.1 µm; e=1.1), subsphaerical, hyaline, thin-walled, IKI-, acyanophilous, 0-1-guttulate; basidia 20-37 x 4-5 µm, cylindrical (ventricose-cylindrical ?), 4-sterigmate, each sterigma ca. 6 µm long, straight, needle-like.

Basidiocarp in section showing a central rounded to flattened darker medulla -180 µm in diam surrounded by a paler cortex; medullary hyphae 2-5 µm in diam, thin-walled, hyaline, or lightly pigmented with thickened walls, dichohyphidia occasionally present; cortex filled with dichophyses,

Fig. B. 1-4. *Gomphus cavipes.* 1. Habit x 0.8. 2. Basidia and basidioles. 3. Spores. 4. Oleiferous hypha. 5-7. *Lachnocladium schweinfurthiana.* 5. Habit x .8 and schematic drawing showing branching of medulla. 6. Basidia, spore, and gloeocystidia. 7. Dichohyphidium from cortex. Bar= 10 µm.


B

faintly stratose, dichohyphidia at base 3-4.5μm in diam, branching dichotomously several times, ultimate branches ending in short acutely tipped dichotomies, walls pigmented, thickened toward the base, those toward the periphery smaller but not coralloid, faintly dextrinoid.

In the field the densely anastomosing fungal mass appears reddish brown with yellowish tips. On closer inspection this appearance is caused by the absence of the pinkish gray hymenium from the ochraceous tips, which contrasts with the darker parts.

Species of *Lachnocladium* are characteristic elements of wet tropical forests. This particular taxon has been reported under a variety of names (Corner, 1967, 1970) from Blumenau and Amazonia, Brazil,E & S. Africa, and from the Congo to Malaya. The present collection demonstrates that this taxon, under appropriate conditions, may grow in warm temperate zones as well.

Corner (1970) restricts **Lachnocladiaceae** to this genus, rejecting Reid's suggestion that *Dichopleuropus* Reid, *Vararia* Karst., *Scytinostroma* Donk, and *Asterostroma* Mass. be included within the family. Boidin (1980) and his colleagues and students have intensively studied *Vararia* and have divided the genus into *Vararia* Karst. and *Dichostereum* Pil. A seventh genus, *Dichocantharellus* Corner (1966) bears some resemblance , i.e., dichophyses and gloeocystidia, to this group. It is tempting to bring these genera together into a single family. However, because of the number of features which appear sporadically throughout the various species, e.g., clamp-connections, sulfocystidia (macrocystidia) amyloid spores, oleiferous hyphae, ornamented spores, it is more discrete at our present level of knowledge to be conservative in our taxonomy.

Ramaria cyanocephala (B. & C.) Corner, Ann. Bot. Mem. **1**: 568. 1950. Fig. C 2-4.

Basidiocarps of many stout cinnamon brown branches very compactly arranged, 7 cm tall x 5 cm wide x 3 cm deep; branching at or near the base, dichotomous with first and second internodes rather long, third internodes relatively quite short and immediately forming dichotomies, frequently one of the ultimate dichotomies suppressed giving the appearance of a trichotomy; branch tips in dried material pale tan (color of fresh material not noted); medullary flesh whitish, pale tan or cream, *bluish green in ferric sulfate solution.*

Costa Rica: Guanacaste Province near Bagaces, 29 Nov 1983, L.D.Gomez & R. Alfaro 22106 in NO.

Spores 10.8 - 15.3 x 6.3-9 μm, thick-walled, yellow brown, with long acute spines, amygdaliform, prominently apiculate. Hyphae thin-walled, clamped, 3-6.5 µm in diam. Basidia 8-12 µm in diam toward apex, 3 µm wide toward base, more than 54 `µm long (base not obs.), bisterigmate.

The general impression of the fructification is that its growth was arrested, although spores are abundant. This is not an unreasonable assumption, for the specimen was collected in a Tropical Dry Forest Moist Providence Transition (see Tosi map in Janzen, 1983) at the end of November when the region is entering one of its driest periods.

A second collection of this taxon has a radically different appearance.

Basidiocarps of many slender cinnamon brown branches laxly arranged, -13 cm tall x 5 cm wide, stem -5 cm long x 5 mm wide, each major segment with 3-6 dichotomies with relatively long internodes , ultimate branches tapering to acute tips; nodal areas flattened (in drying?); tips darkened or concolorous; medullary flesh whitish to pale tan , *bluish green in ferric sulfate solution.*

Costa Rica : Puntarenas Province, Finca El Eden, Km183, Rt. 2, 6 Sep 1983, Gomez 22966 (NO)

Spores 9.9-13 x 6.3-7.2 µm Hyphae 2-10 µm in diam,thin-walled,clamped. Basidia 6.3-9 µm in diam, with two stout sterigmata -9 µm long. Microscopically similar to Gomez & Alfaro 22106.

Macroscopically the two specimens are similar only in their color. Microscopically they are practically identical. The taller, more lax collection (Gomez 22966) was made in southern Costa Rica in a region of Tropical Moist Forest in a wet month. Climatic difference may help explain the difference in macroscopic appearances of these specimens (assuming the determinations are correct). Clavarioid fungi have an open growth plan, and more abundant moisture would allow maximum elongation of the branches, which would help develop a less compact, more lax and open fructification. The reverse would be true in a regimen of declining moisture.

Ramaria zippelii (Lév.) Corner, Ann. Bot. Mem. 1: 632. 1950.

Basidiocarps- 5 cm tall, bushy, branches tan to brown mixed with purple brown toward the base, some purple brown upon injury, tips greenish yellow to pinkish; medullary flesh tan to brownish, *not reacting to ferric sulfate solution.*

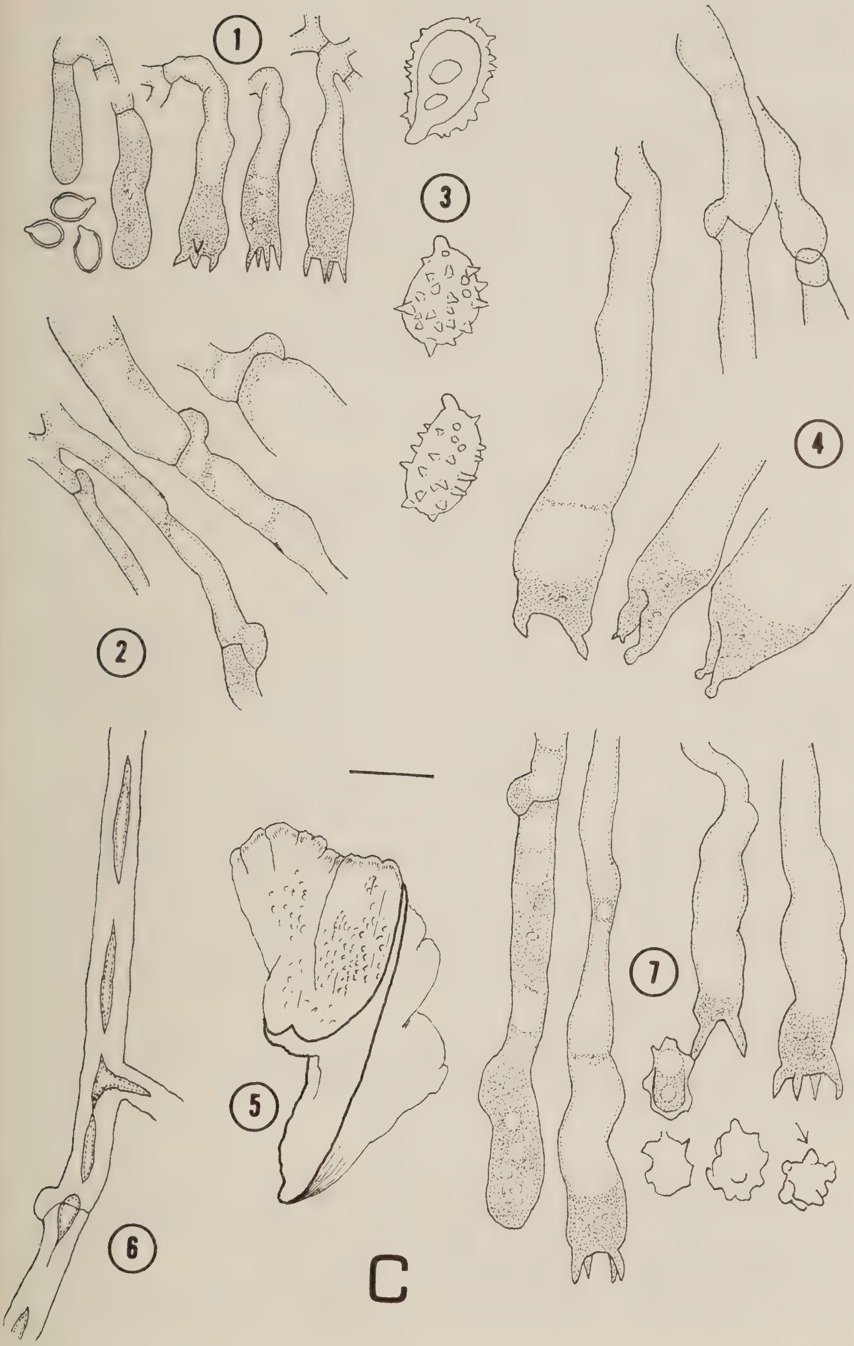
Trinidad: near Arima in the Northern Range. ALW & Lemke 1664, 1745, 1759, 1771, all kindly determined by Professor Corner as *R. grandis* (Pk.) Corner and later synonymized by him with *R. zeppelii*.

Spores typical of the subgen. *Echinoramaria* ser. *Grandisporae*, 10-16 x 6.5-9.5 µm. Basidia bisterigmate.

Corner (1967,1970) has emphasized the difficulty of differentiating *R. cyanocephala* and *R. zeppelii* without field notes on fresh material, especially the color of the branch tips. In his key to ser. *Grandisporae* Corner lists 4 taxa which have predominantely bisterigmate basidia. *Ramaria nigrescens* (Brinkm.) Donk and *R. apiahyana* (Speg.) Corner were eliminated because of their orange color and the blackening of the flesh in the former species. Specimens of *R. cyanocephala* with purple tips collected from Jamaica (ALW 487) and Trinidad (ALW 1719), the former confirmed by Professor Corner, have a whitish medulla and become bluish green in ferric sulfate solution. Our specimens of *R. zippelii* lack this reaction and the medulla is darker.

That at least some ramarias react to ferric sulfate solution (Donk, 1964; Marr & Stuntz, 1973) is well-known. According to the latter authors only a few taxa among those from Washington state (*R. amyloidea*, *R. celevirescens*, *R. claviamulata*, and *R. velocimutans*, all new species) react instantly and dramatically. In addition to *R. cyanocephala* and *R. zippelii* there are seven other taxa in NO. Reacting immediately to ferric sulfate solution are: *R. flavobrunnescens* (Atk.) Corner, *R. mollerana* (Bres. & Roum.) Corner, *R. stricta* (Fr.) Quel., and *R. verna* (Coker) Corner, whose reaction occurs in the region at the base of the cortex and not in the medulla proper. Not reacting, or reacting faintly at best, are: *R. aurea* (Fr.) Quel., *R.* cfr. *formosa* (Fr.) Quel., and *R. guayensis* (Pat.) Corner. Our material is dried and some of our specimens are several years old. Specimens of *R. cyanocephala* and *R. zippelii* from Trinidad were collected 28 years ago, and *R. cyanocephala* still reacts instantly to ferric sulfate. Even though little is known of the relationship of this reaction to basidiocarp age, and that such tests are best performed on fresh material, it is noteworthy that among the specimens available to us the reaction distinguishes the two taxa. We recognize the Costa Rican specimens as *R. cyanocephala* because: (a) their microscopic features are essentially those of *R. cyanocephala*, (b) they react instantly and definitively to ferric sulfate, (c) the only other similar taxon, *R. zippelii*, does not react, and (d) known specimens of *R. cyanocephala* of the same age as *R. zippelii* specimens also react instantly to ferric sulfate.

Fig. C. 1. *Gyrodontium versicolor*. Basidia, basidioles, and spores. 2-4. *Ramaria cyanocephala*. 2. Generative hyphae, some inflated. 3. Spores. 4. Basidia, middle one with a minutely branched sterigma, and generative hyphae. 5-7. *Thelephora aurantiotincta*. 5. Habit x 0.8. 6. Generative hypha with occluded lumen. 7. Basidia, basidiole, and spores. Bar = 10µm.


C

Thelephora aurantiotincta Corner, Beih. Nov. Hedw. 27:44. 1968. Fig. C 5-7.

Basidiocarp -7 cm tall x 6.6 cm wide (a portion of the base broken off), with a very strong smell of fenugreek, foliaceous, imbricating from a common stem, intricately fused, segments thick, not cyanescent in KOH but darkening (pale brown) in KOH and ferric sulfate solution; abhymenial surface matte, off-white to pale cream, spiculose-striate, striae caused by groups of repent hyphae, these sometimes purplish brown, especially toward the margin, azonate; margin thick, blunt, as if arrested in development, stained purplish brown, streaked this color toward base; adhymenial surface pallid white except toward margin and where papillae develop; papillae distinct, ca. 0.5 mm high, but tips soon purplish brown giving a light brown tone to the older parts, younger portions fading toward margin from orange through pale orange to white.

Mexico: ca. Atocuapan, Km 2.5 Totula-Xalapa highway , alt. 1350 m, Veracruz, terricolous ?, 23 Jul 1984, leg. A. Sampieri 915 (XAL, NO).

Spores 5.8 - 7.2 µm, lobate, angles minutely crispate, apiculus 1 - 1.5 µm long, fuscous vinaceous, IKI-.

Monomitic with clamped hyphae 3-7 µm in diam, thin-walled or with sclerified segments, these with capillary to occluded lumena, wider thin-walled hyphae often with simple secondary septa, sclerotized hyphae occuring singly or in small groups traversing the context. Basidia 54-56 x 7.2 µm, 4-sterigmate, cylindrical clavate; cystidia absent.

Corner (1968) described this taxon as growing in humus of a mountain forest (Mt. Kinabalu) in N. Borneo at ca. 1600 m alt. As he notes, *T. aurantiotincta* is a remarkable member of its genus. It would immediately catch the eye of any collector passingly familiar with *Thelephora*. A second intriguing feature is the similarity of habitat in widely separated areas. This report represents only the second time this taxon has been reported. It will be interesting to learn in the future if similar habitats in other areas of the tropics also support this fungus.

A sterile floccose hymenochaetoid fungus was growing over the abhymenial surface of this collection. The complete lack of spores and basidia precludes determination.

ACKNOWLEDGEMENTS

The authors are grateful to a number of agencies and individuals for making it possible to assemble not only specimens of the fungi reported here, but for other specimens which have been invaluable in our comparative studies. The agencies are the National Science Foundation (ALW to collect in the Lesser Antilles, Central America, and Mexico) and the Tinker Foundation through the Mesoamerican Ecology Institute of the R.T. Stone Center for Latin American Studies of Tulane University (ALW & CLO). C.L.Ovrebo's collecting in Colombia was supported by R. E. Halling (NSF grant BSR - 860024). Individuals who have sent specimens are Dr. Gaston Guzman of Mexico and L. D. Gomez of Costa Rica. Prof. E.J.H. Corner kindly identified a large number of clavarioid fungi.

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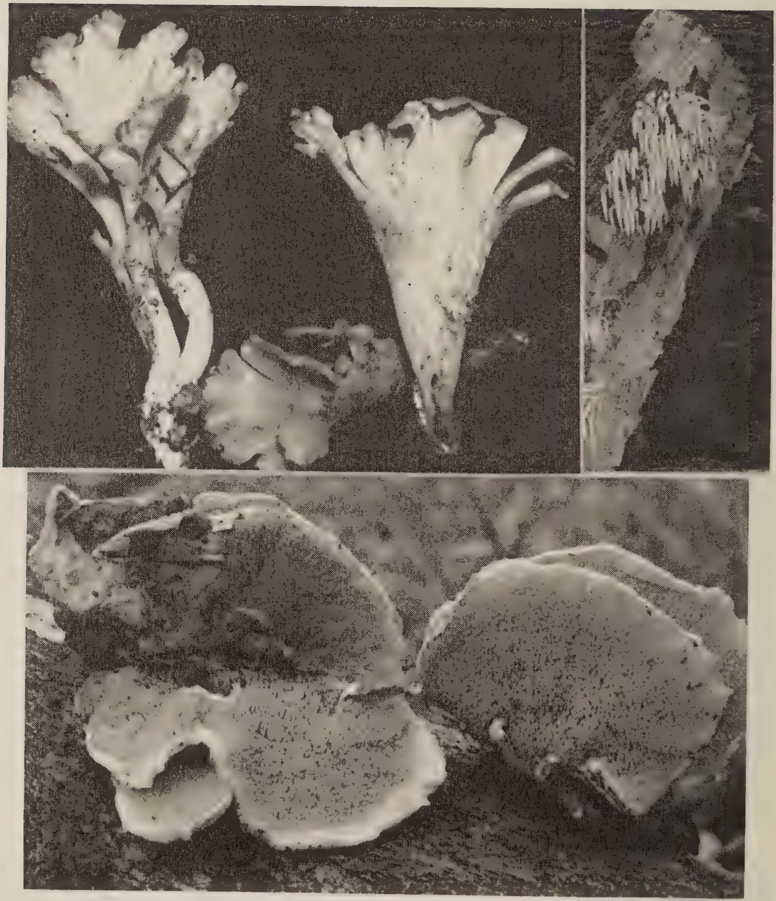

Plate 1. *Gomphus cavipes.* Upper left ca. x 1. *Deflexula subsimplex.* Upper right ca. x 1. *Gyrodontium versicolor*. Below ca. x 1. Photos by C. L. Ovrebo.

MYCOTAXON

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AMANITA PROTECTA—A NEW SPECIES FROM COASTAL SOUTHERN CALIFORNIA

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Summary

Amanita protecta is described as new from the coastal region of southern California.

Amanita protecta Tulloss & Wright sp. nov. Holotypus: California, Los Angeles County, Santa Monica Mountains, Stunt Canyon, 3.i.1987 Barry Silver [Wright 1383A = Tulloss 1-3-87-BS1] (NY[1]).

Etymology: *protectus*, protected—referring to the thick universal veil in this species.

Pileus griseolus vel griseus vel brunneo-griseus, 40 - 115 *mm in mensura diametrica, margine striata, nonappendiculata; materies volvica fibrillo-coacta, alba vel subcinerea, et, juxta marginem, pallida, rara, pulverulenta. Lamellae confertae, liberae vel anguste adnatae, margine grisea vel griseo-brunnea. Stipes* 80 - 130 × 10 - 22.5 *mm, pallidus, fibrillis griseis vel griseo-brunneis. Volva circumsciscens vel lobata, alba vel albida, a stipe remotissima,* 20 - 40+ *mm alta. Caro albida vel subgriseola, decolorationibus denique ochraceis. Basidiae tetrasterigmaticae,* (53.5-) 60.5 - 92 × 13.5 - 16.5 (-17.5) µ*m; fibulae absentes. Sporae* (8.7-) 9.4 - 12.6 (-14.7) × (7.3-) 8.4 - 11.2 (-13.3) µ*m, globulosae vel subglobulosae vel late ellipsoideae vel ellipsoideae, nonamyloideae.*

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[1]
F - Herbarium of the Field Museum of Natural History, Chicago, Illinois, U.S.A.
NY - Herbarium of The New York Botanical Garden, Bronx, U.S.A.

All collections with no herbarium location cited are in Tulloss' private herbarium.

Amanita protecta (Fig. 1) is a member of section *Vaginatae*. It is a medium-sized mushroom with gray to gray-brown pileus, an exannulate stipe covered for much of its length with dark gray to black fibrils, and a robust universal veil leaving thick felted/fibrillose patches over a layer of fine pulverulence on the pileus and a thick, lobed, volva at the stipe base. The volval limb is rather widely separated from the stipe by a gap partially due to the fact that the inner 1-2 mm of the volva is carried up on the expanding pileus. All parts of the basidiocarp have a tendency to develop ochraceous stains when damaged and due to aging. The context of the pileus and stipe, as well as the universal veil tissue, display many terminal hyphal segments and terminal inflated cells (sometimes in chains) with thick walls. In the portion of the universal veil below its desiccated surface, the hyphae are coiled and twisted. The basidia of this species can be quite long for the genus. Clamps were observed only in the stipe context where they were very rare.

PILEUS: 40 - 115 mm diam, from pale to dark gray or ''brownish grey'' or deep brownish gray (11D-E2[2]), viscid when moist, becoming shiny when dry, convex expanding to plano-convex with deflexed margin to finally concave, occasionally deeply rimose; margin weakly striate to striate (0.1R - 0.25R); universal veil up to 3 mm thick, occasionally appearing to have two layers (then the ''outer layer'' thin, whitish with ochraceous staining, rather fragile, submembranous), otherwise whitish or pale grayish at first, eventually cream or grayish with ochraceous stains, subatomate to atomate, in large floccose-felted patches becoming smaller toward margin where the remnants are reduced to a fine pulverulence, detersile; context 4± - 10 mm thick at disk thinning evenly to margin or to about 90% of radius and then a membrane to margin, firm, whitish to pale grayish, becoming faintly pink or ochraceous on exposure, occasionally dark grayish below the pileipellis in disk. LAMELLAE: close, 4.5 - 12.5 mm broad, free to very narrowly adnate with a white decurrent line on stipe, white with a dark gray or gray-brown margin, unchanging, after drying 4A-B3 or 5A4 or 2.5Y 8/2-4 or 7.5YR 8/6; margin minutely fimbriate (lens); lamellulae truncate, frequently with line of truncation concave, occasionally anastomosing with neighboring lamellae. STIPE: 80 - 130 × 10 - 22.5 mm, white to pale grayish at apex, creamy white to grayish with ochraceous stains for 10 - 20 mm above attachment of volval sac (sometimes with pallid silky fibrils in this area), otherwise medium gray to very dark gray to gray-brown fibrils (sometimes in chevron pattern) on a sordid ground, subcylindrical, flaring at apex, without bulb, rounded to somewhat pointed at base, staining ochraceous with exposure; context white above and white, fulvous, tannish, or salmon-cinnamon in base, faintly becoming pink or staining ochraceous, the discoloration becoming more intense toward the base, stuffed, central cavity diam about one third to one half that of stipe, or rarely solid, at times becoming hollow near base; exannulate; universal veil saccate, subcircumscissile to limbate, highest point of limb reaching to 20 - 40+ mm from stipe base, up to 5 mm thick at point of connection to stipe, surface white to whitish with ochraceous stains, occasionally the surface

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[2] Color codes of the form ''11D2'' and associated color names in double quotation marks are from (Kornerup & Wanscher, 1978). Color codes of the form ''7.5YR 8/6'' are from (Munsell Color, 1975).

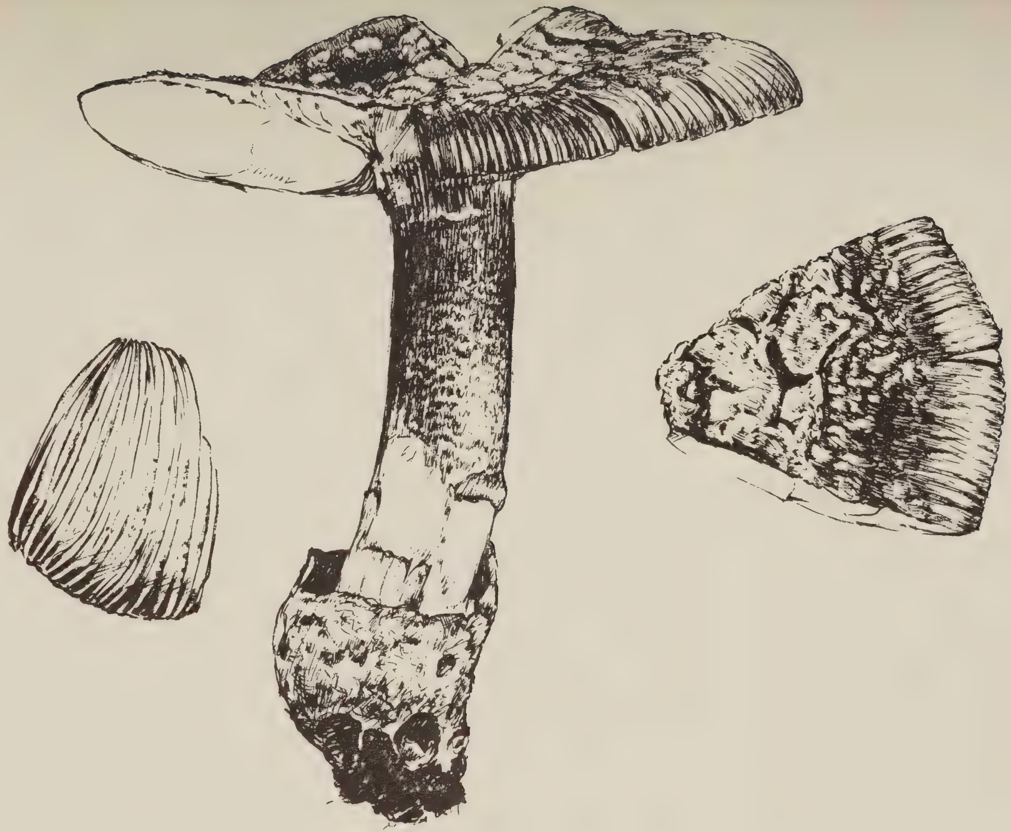
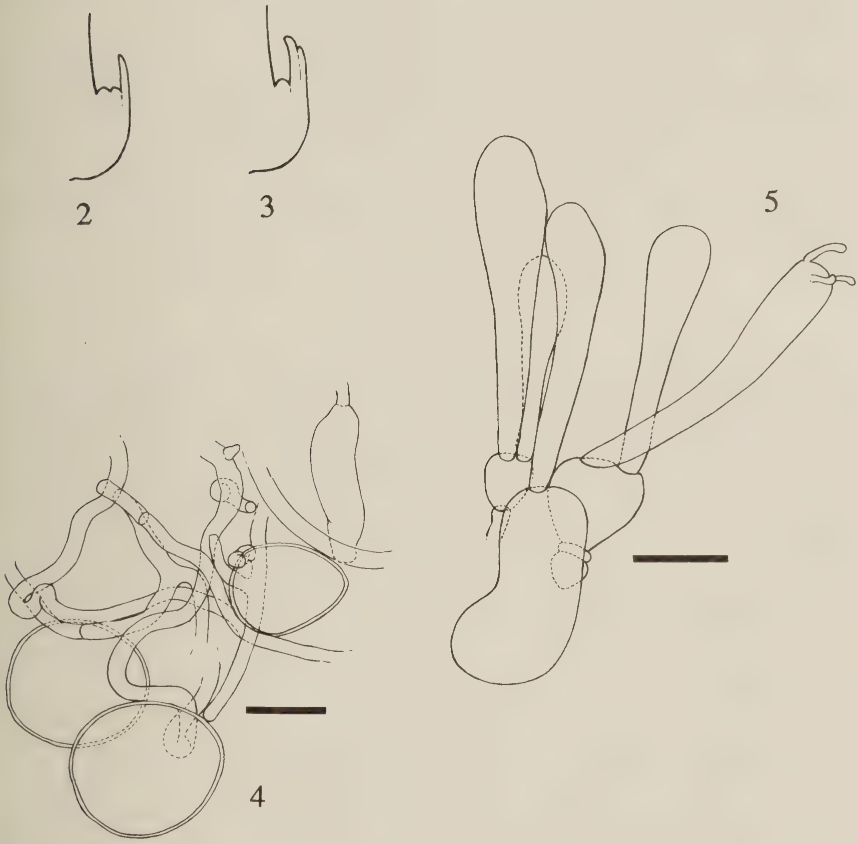


Fig. 1 *Amanita protecta*. Tulloss 1-3-87-BS1 [×0.9].

dessicates producing a thin, submembranous to hardened or shell-like ''outer layer'' sometimes having the texture of a chicken eggshell; interior pale grayish white to grayish, floccose-felted, at times largely carried up onto pileus so that the ''outer layer'' forms a limb separated considerably from the stipe, occasionally leaving only one or more concentric ridges between the volval sac and the stipe (Fig. 2), occasionally remaining as a separate second limb (not a limbus internus) which may even project above the limb formed by the ''outer layer'' (Fig. 3); no noticeable limbus internus. Odor slightly sweet (Wright) to faintly unpleasant in age (Tulloss). Taste slightly sweet (Wright). Wright experienced no symptoms of poisoning after eating about 30 g of the cooked mushroom. Meixner test (Vergeer, 1986) negative for amatoxins—unreactive or dull orangish or orange-reddish with a yellow ring around the acid drop. Paracresol spot test for tyrosinase (Marr, 1979) positive except in universal veil, lamellae, marginal pileus context, and very base of stipe. Syringaldazine spot test for laccase (Marr, 1979) negative. Phenol on stipe: wine-red. KOH on pileus: no reaction.

PILEIPELLIS: up to 560 μm thick, composed of interwoven, undifferentiated, filamentous, frequently branching hyphae 2.1 - 3.5 μm diam, gelatinizing near surface, not having a clear boundary with pileus context. PILEUS CONTEXT: a tangle of interwoven, filamentous, undifferentiated, branching hyphae 3.5 - 10.5 μm diam, with lengthy, thick-walled (wall thickness here and below to 1.2 μm except as noted), terminal or subterminal segments inflated up to 28 μm diam; inflated cells thick-walled, plentiful, terminal singly or in chains, subglobose to pyriform to clavate to elongate to irregular, up to 106 × 63 μm (the larger cells more often elongated than the smaller); branching oleiferous hyphae 2.5 - 5.0 μm diam, common. LAMELLA TRAMA: bilateral; branching, undifferentiated, filamentous hyphae 3.5 - 5.6 μm diam; inflated cells to 70 × 24.5 μm, thin-walled, intercalary; oleiferous hyphae present, but not common, 3.5 - 4.9 μm diam. SUBHYMENIUM: slightly inflated ramose to subcellular to cellular. BASIDIA: (53.5-) 60.5 - 92 × 13.5 - 16.5 (-17.5) μm, narrowly to very narrowly clavate, 4-spored, rarely 3- or 2-spored, thin-walled; clamps not seen. UNIVERSAL VEIL: On the stipe base at the surface: composed largely of gelatinizing, undifferentiated, filamentous, branching hyphae 4.2 - 5.9 μm diam, disorderly, intertwining or in intertwining fascicles, some with intercalary and/or terminal segments slightly inflated to 19.6 μm diam; clavate terminal cells up to 77 × 25 μm; pyriform to lachrimiform cells up to 65.1 × 44.1 μm; occasional oleiferous hyphae 3.5 - 4.2 μm diam; tissues difficult to reinflate. On the stipe base below the surface: Below a depth of about 1 mm, before inflation, the tissue seems mainly composed of intertwining fascicles of hyphae which surround minute lacunae; when reinflated, the tissue is seen to be composed of undifferentiated, filamentous, branching, tightly coiled or twisted hyphae 3.1 - 8.0 μm diam with terminal and subterminal sequences of hyphal segments often inflated up to 14.0 μm diam; scattered oleiferous hyphae 4.9± μm diam; frequent inflated cells thin- or thick-walled, terminal, subglobose to ellipsoid up to 64 × 50.5 μm and clavate up to 126 × 33 μm. On the pileus: nearest pileipellis, dominated by globose to subglobose to ovoid inflated cells, terminal, singly or in chains of up to 4, thin- and thick-walled (these with wall thickness to 1.5 μm), up to 61.6 × 52.5 μm; undifferentiated, filamentous, extensively branching hyphae 2.1 - 8.4 μm diam which, in a very thin layer just above the pileipellis, sometimes gelatinize leaving only inflated cells in that region. Further from pileus, hyphae becoming more curved and showing some coiling as in veil at stipe base, with terminal and subterminal segments inflated to 14 μm diam; terminal subglobose to clavate cells thick-walled, up to 56 × 29.4 μm. STIPE CONTEXT: acrophysalidic; branching, filamentous, undifferentiated hyphae, 2.8 - 4.9 μm diam; oleiferous hyphae 10.5 - 12.6 μm diam, not common; dominated by thick-walled acrophysalides up to 215 × 52 μm (most narrower); clamps very rare. All tissues pale yellow in 2% KOH or 10% NH_4OH.



Figs. 2-5 *Amanita protecta*. 2. Diagram of stipe base and universal veil with inner layers of volva largely carried away on the pileus. 3. Diagram of stipe base and universal veil with most of the interior of the universal veil remaining attached to its dessicated external surface. 4. Universal veil elements from patch on pileus (Tulloss 1-3-87-BS1). 5. Elements of hymenium and subhymenium (Tulloss 1-3-87-BS1). The bars in Figs. 4 and 5 represent 20 μm.

BASIDIOSPORES: [140 spores from 7 specimens measured in Melzer's reagent] (8.7-) 9.4 - 12.6 (-14.7) × (7.3-) 8.4 - 11.2 (-13.3) μm, (average length (per specimen) = 10.3 - 11.4 μm; average length (overall) = 11.0 μm; average width (per specimen) = 9.3 - 10.2 μm; average width (overall) = 9.7 μm; Q = 1.0 - 1.23 (-1.43); average Q (per specimen) = 1.09 - 1.19; average Q (overall) = 1.13), inamyloid, thin-walled, hyaline, smooth, globose to subglobose to broadly ellipsoid, occasionally ellipsoid, sometimes slightly expanded at one end, frequently adaxially flattened or slightly so; contents guttulate; apiculus sublateral, truncate conic; white in deposit.

Distribution and habitat: Solitary to gregarious under *Quercus agrifolia* Née, December to March, in coastal southern California to 800 m elev.

Collections examined: CALIFORNIA, Los Angeles Co., Santa Catalina Island, Grand Canyon, 27.xii.1920 L. W. Nuttall 988 (F, as *A. velosa*), Santa Monica Mtns., Stunt Canyon, 3.i.1987 Barry Silver [Tulloss 1-3-87-BS1, Wright 1383A] (holotype, NY), 10.i.1987 B. Silver [Wright 3701], Riverside Co., Santa Ana Mtns., El Cariso, 17.ii.1987 G. Wright 3701A, Slaughterhouse Canyon 3.iii.1987 G. Wright 3712, Santa Barbara Co., Santa Ynez Mtns., Los Prietos Campground, 30.iii.1979 Florence Nishida [Wright 1383].

DISCUSSION

The most remarkable macroscopic feature of *A. protecta* is its universal veil. In some specimens the veil appears to have a tough outer layer covering a second layer of floccose-felted material which is separated from the pileus by a third, pulverulent layer. Microscopically, the sometimes hardened surface is revealed to be a desiccated layer of tissue nearly identical to that underlying it; the portion of the veil nearest the pileus is composed mostly of small inflated cells, sometimes in chains, which make up the fine pulverulent layer visible where no volval patch is present. In Section *Vaginatae*, this form of universal veil is known only from the present species.

The upper limit for the length of basidia in *A. protecta* considerably exceeds that for any taxa described by Jenkins (1986).

To our knowledge, the presence of thick-walled inflated cells in the pileus and stipe contexts and in the universal veil has not been commonly recorded in *Amanita*. We at first considered that this might be a character which evolved to resist desiccation; however, the situation cannot be so simple; the character is found also in *A. mortenii* Knudsen & Borgen (known only from southwestern Greenland) (Knudsen & Borgen, 1987), in at least the hyphae of *A. peltigera* Reid (Reid, 1980), and in *A. phalloides* (Fr.) Link in Wildenow in which the character has been observed in English, North American, and Australian collections according to Reid (1980) and Tulloss (1988). In Tulloss' current studies of *Amanita* section *Amidella*, thickened cell walls have proven to be rather common.

In the field, if the limb of the volval sac were completely broken away, one might mistake this species for a member of Section *Amanita* close to *A. pantherina* (DC. : Fr.) Krombh. because the specimen would appear to have a cothurnate, even abrupt, bulb; however, the peculiar character of the volval material remaining on the pileus, the dark gill margins, and the dark fibrils on the exannulate, completely elongating (bulbless) stipe should serve to prevent such an error.

Amanita constricta Thiers & Ammirati is a species of section *Vaginatae* with grayish to brownish pileus, grayish stipe, and grayish margins to its lamellae (Thiers & Ammirati, 1982). This entity can be distinguished from *A. protecta* by having a sulcate to tuberculate sulcate pileus margin and a thinner, constricted and flaring, membranous universal veil that reaches up one third to one half of its stipe and bruises reddish or salmon when moist. Arora (1986: 289) provides a good photograph of the universal veil of *A. constricta*. The lamellae of *A. constricta* turn gray or grayish with age.

Amanita pseudovaginata Hongo has some macroscopic similarities to *A. protecta* (gray material on stipe and gill margins and a relatively robust stipe base), but is smaller according to Hongo (1983). Also, the spores of *A. pseudovaginata* are much narrower (7 - 9 (-9.5) µm) and the basidia shorter (40 - 58 µm).

Nuttall 988 was determined originally to be *A. velosa* (Pk.) Lloyd; this latter species has a pallid, yellowish to orangish pileus; a relatively pointed stipe base; narrower spores; no marked tendency to ochraceous staining in the tissues; a more membranous volva which does not break up into pulverulence and floccose patches on the pileus and which tends to leave a single membranous calyptra over the disk; etc.

ACKNOWLEDGMENTS

We are grateful to Dr. David T. Jenkins, University of Alabama at Birmingham, for his review of this paper and for the opportunity to discuss matters of presentation in some depth. We thank Dr. Cornelis Bas, Rijksherbarium, Leiden, The Netherlands, for reviewing the article and for advice on selecting the specific epithet. Dr. Gregory M. Mueller, Field Museum of Natural History, Chicago, Illinois, graciously hosted Tulloss at F and provided a loan of material for which we extend our thanks. We thank Mr. Barry Silver, Arcata, California, for supplying two collections; Ms. Allison Petrilla, Roosevelt, New Jersey, for assistance with Latin; Ms. Mary A. King, Roosevelt, New Jersey, for assistance with document preparation; and Mr. Neal Macdonald, Princeton, New Jersey, for preparing the illustrations.

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CONTRIBUTION TO THE STUDY OF THE *MYXOMYCETES* IN SPAIN. I.*

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ABSTRACT

44 species of *Myxomycetes* are reported from several localities of peninsular Spain. The following taxa are new to Spain: *Badhamia dubia* Nann.-Brem., *Diderma chondrioderma* (de Bary & Rostaf.)G. Lister and *Didymium karstensii* Nann.-Brem. Two new species are described: *Diacheopsis nannengae*, characterized by its spherical and warted spores (9-11 µm diam.) and its abundant brown filamentous capillitium, and *Didymium marineri*, characterized by its limeless stipes, its whitish convex columella and its warted spores with a darker zone (9-10 µm diam.). All these taxa are fully described and figured with microphotographs of their most important taxonomical features.

INTRODUCTION

In addition to our recent research (MORENO & al., 1987; HEYKOOP & al., 1988) we start with this paper a series of studies on the taxonomy and chorology of the *Myxomycetes* of the spanish peninsula.

The microphotographs were made under a Nikon microscope model Optiphot, with an incorporated system of automatic photography and under a Zeiss stereoscopic microscope model DRC. The microscopical examinations were made in a 5% KOH solution with a pretreatment in 96º alcohol.

The material examined is kept in the herbarium of the Department of Plant Biology (Botany) of the University of Alcalá de Henares (H.AH).

CATALOGUE OF SPECIES LISTED ALPHABETICALLY

Amaurochaete atra (Alb. & Schwein.) Rostaf.
AVILA: Casavieja, on a dead branch of *Pinus pinaster*, 4-VI-1988, *B. Fransesch, P. Sánchez & C. Illana*, H.AH 11044.

Arcyria cinerea (Bull.) Pers.
MADRID: Somosierra, on dead wood of *Betula alba*, 24-VI-1988, *C. Illana, G. Moreno & F. Esteve-Raventós*, H.AH 11020 and 11036.

Arcyria incarnata (Pers.) Pers.
GUADALAJARA: Centenera, on a carpophore of *Trametes trogii*, 6-XI-1987, *D. Mustieles & R. Moratilla*, H.AH 10952.
MADRID: Somosierra, on dead wood of *Corylus avellana*, 24- VI-1988, *C. Illana*, H.AH

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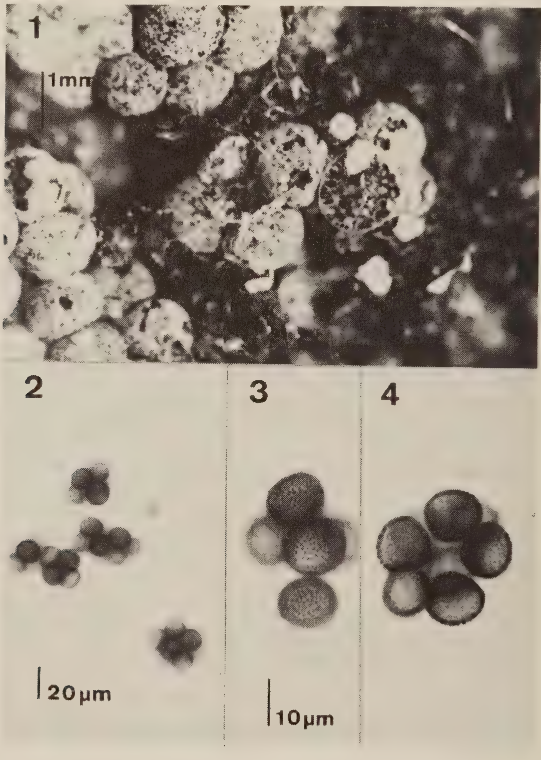
[*] This paper was presented at the "IV Reunión Conjunta de Micología" celebrated in La Manga, Murcia (3-5 October 1988).

11023, Alcalá de Henares (Finca La Oruga), on soil in a meadow in poplar grove, 30-I-1988, *C, Illana*, H,AH 10947,

Arcyria obvelata (Oeder) Onsberg
SEGOVIA: Mountain pass of la Quesera, on dead wood of *Fagus sylvatica*, 16-IX-1982, *G, Moreno*, H,AH 11033,

Arcyria pomiformis (Leers) Rostaf.
CIUDAD REAL: Sierra de Riofrío, on a branch of *Betula parvibracteata*, 15-VII-1982, *G, Moreno, S, Rivas-Martínez & M, Peinado*, H,AH 10935,

Badhamia dubia Nann.-Brem. (Fig. 1-4)
PONTEVEDRA: La Lanzada, internal part of the bark of *Pinus* sp., 14-V-1983, *J,L, González*, H,AH 11002,



Figs, 1-4, *Badhamia dubia*: Sporocysts and spores (H,AH 11002)

Comments: this species is characterized by its crowded, sessile, greyish-whitish with abundant $CaCO_3$ sporocysts, 0,5-1,5 mm diam. Spores in tight clusters, globose to subglobose, 9-11 µm diam., strongly warted. The capillitium is typically "badhamioid" and whitish.

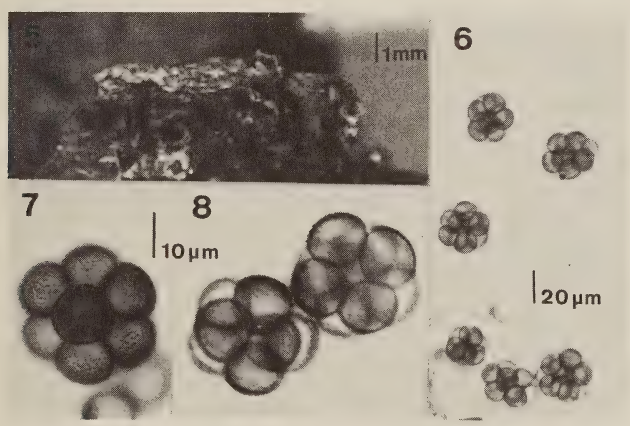
This is a new contribution to the national catalogue of *Myxomycetes*. Gracia (pers. comm.) has collected it in Cataluña on bark of *Olea europaea*.

Badhamia foliicola Lister
CASTELLÓN: Oropesa del Mar, on a branch of *Prunus amygdalus*, 3-I-1984, *G. Moreno*, H.AH 10931.
MADRID: Mountain pass of Canencia, on dead leaves of *Cistus ladanifer*, 8-XII-1983, *G. Moreno & F. Esteve-Raventós*, H.AH 10932. Húmera, on rests of *Poaceae*, 28-IX-1986, *G. Moreno*, H.AH 11032.

Badhamia panicea (Fr.) Rostaf.
MADRID: Cercedilla, stem of *Ailanthus altissima*, 16-XI-1982, *G. Moreno*, H.AH 10930.

Badhamia utricularis (Bull.) Berk.
MADRID: Mountain pass of Canencia, on the bark of *Quercus pyrenaica*, 8-XII-1983, *G. Moreno & F. Esteve-Raventós*, H.AH 10916 and 10929.

Badhamia versicolor A. Lister (Fig. 5-8)
MADRID: Miraflores de la Sierra, on the bark of *Ulmus minor* among lychens and mosses, 8-XII-1983, *G. Moreno & F. Esteve-Raventós*, H.AH 10909 (duplo in the private herbarium of Nannenga-Bremekamp sub nº 16120) and 10922.



Figs. 5-8. -*Badhamia versicolor*: Sporocysts and spores (H.AH 10922)

Comments: our collections present sessile sporocysts, scattered to gregarious, yellow to whitish-yellowish, 0,3-1 mm diam. Spores in hollow clusters, warted on the outside nearly smooth on the inside of the cluster, which desintegrate in part under slight pressure into free spores. Comparison with other specimens seems to indicate that there are two forms of *B. versicolor*, viz. one with spores in hollow regular and rather irregularly ovoid clusters of ovoid spores, and the other with more or less spherical only, hollow clusters of relatively shorter, turbinate spores (Nannenga-Bremekamp, pers. comm.).

This species is very close to *B. nitens* Berk. because they both have spores with "caps" of warts on the outside and they are smoother to smooth on the inside of the cluster. It differs from it because *B. nitens* presents more or less solid (and not hollow) clusters of, usually darker, spores.

Craterium leucocephalum (Pers.) Ditmar
MALLORCA: Gorg Blau, on leaves of *Quercus ilex*, 2-V-1983, *J.L. Siquier*, H.AH 10933.

Cribraria vulgaris Schrader
PONTEVEDRA: La Lanzada, on branch of *Pinus* sp., 14-V-1983, *M. Cruz*, H.AH 10934.

Diacheopsis nannengae Moreno, Illana & Heykoop, **sp. nov.** (Fig. 9-13)

Etymology: in honour of Mrs. N.E. Nannenga-Bremekamp, because of her contribution on the knowledge of *Myxomycetes*.

Sporangia 0,4-1 mm diam., globosa, sessilia aut seiuncta aut gregaria, argentea, iridescentia.

Sporae sphaericae 9-11 µm diam., violaceo-brunneae, verrucosae. Capillitium filamentis brunneis intermixtis constitutum aut laevibus aut nodosis, 1-2 µm diam. Plasmodium ignotum.

Habitat: in cortice ramorum mortuorum Pini sylvestris, Montejo de la Sierra (Madrid), 15-IV-1983, *leg.* G. Moreno, *Holotypus* H.AH 11005.

Sporocysts globose, 0,4-1 mm diam., sometimes shortly prolate, sessile, scattered to gregarious. Peridium very fine, membranous, silvery or iridescent with blueish, purplish or violaceous tints. Dehiscence irregular and generally from the apex.

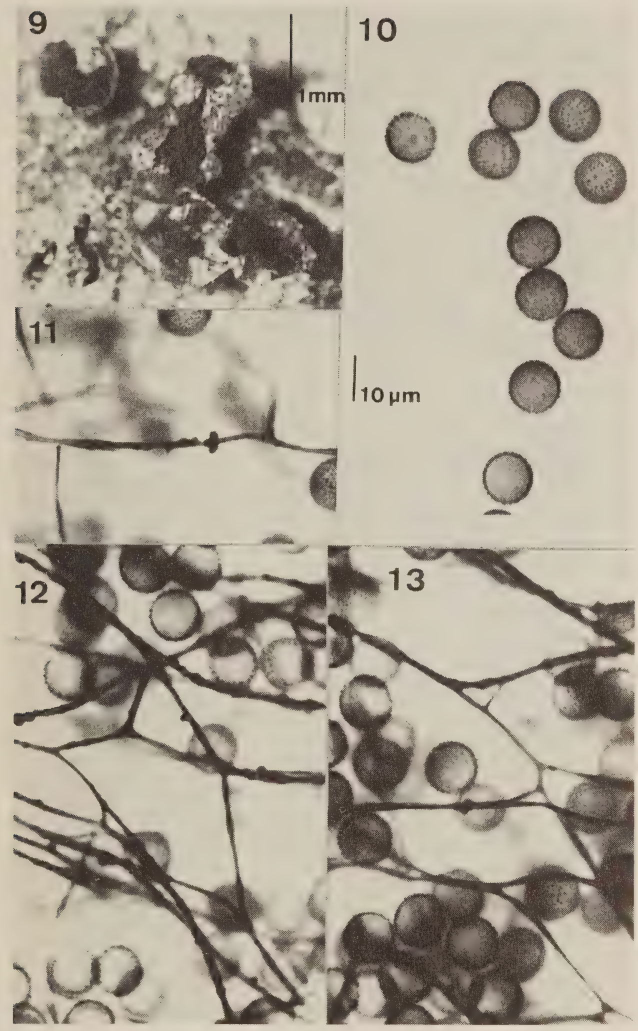
Spores spherical, 9-11 µm diam., violet-brown to dark brown in mass, in transmitted light showing distinct warts which are irregularly distributed, small crests can be observed under phase-contrast microscope, which sometimes coalesce into a broken reticulation. Capillitium abundant, brown, connected to the base of the sporocyst, forming, under the microscope, a tangle of wide and irregular net of anastomosing filaments , sometimes with big concolorous ellipsoidal nodes (e.g. 20 x 5 µm). Plasmodium not observed.

Habitat: on the bark of a dead branch of *Pinus sylvestris*, Montejo de la Sierra (Madrid), 15-IV-1983, *G. Moreno*, *Holotypus* H.AH 11005. (*Isotypus* in the private herbarium of Nannenga-Bremekamp sub nº 15064).

Comments: *Diacheopsis nannengae* is characterized by its rather small spores (9-11 m diam.) combined with its abundant brown capillitium

It is close to *D. picninica* Krzemieniewska, but the latter has even smaller spores (6-7 µm diam.) and its sporocysts are cylindrical (vide KOWALSKI, 1975). With *D. depressa* Thind & Lakhanpal, as described from India, it shares the spore size (9-10 µm diam.) but it differs from it in its brown not hyaline capillitium, (KOWALSKI, 1975).

We place this new species in the genus *Diacheopsis* instead of in *Colloderma* because the latter presents a gelatinous peridium. No trace of this gelatinous layer has been observed in the sporocysts of our species, not even under phase-contrast microscope.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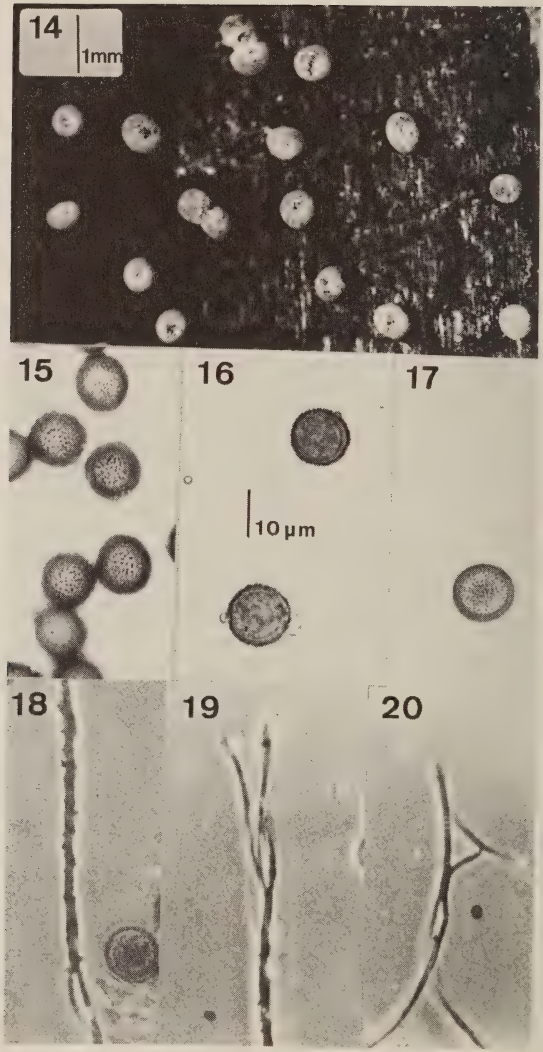
13

Figs. 9-13.- *Diacheopsis nannengae*: Sporocysts, spores and capillitium (Holotypus)


14
1mm
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17
10 µm
18
19
20

Figs. 14-20 - *Diderma chondrioderma*: Sporocysts, spores and capillitium (H,AH 11013)

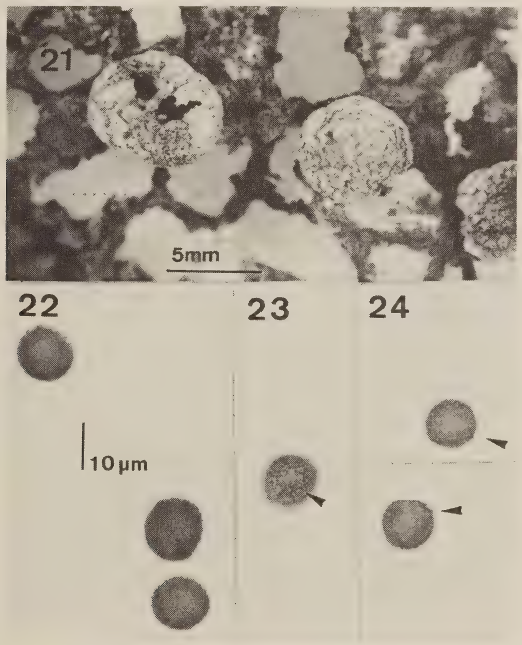
Diderma chondrioderma (de Bary & Rostaf.) G. Lister (Fig. 14-20)
MADRID: Alcalá de Henares, on bark rests of *Populus alba*, 15-XI-1987, *J. Díez*, H.AH 11013.

Comments: our collection presents stalked sporocysts, 0,4-0,8 mm diam., discoid to umbilicate, depressed around the stipe apex, whitish to slightly greyish and with abundant lime deposits. Stipe whitish to pale straw-yellowish, up to 0,5 mm of length. Columella globose, whitish to very pale straw colour. Spores smooth, spherical, 11-12,5 µm diam., purple-grey and densely warted. Capillitium hyaline to very pale brown, 1-3 µm diam.

This is a new contribution to the national catalogue of *Myxomycetes*.

Diderma spumarioides (Fr.) Fr.
MADRID: Alcalá de Henares (Puente Zulema), on *Poaceae* in pine grove of *Pinus halepensis*, 5-II-1988, *J. Prieto*, H.AH 10996.
MALLORCA: Road from Lluch to Soller, on leaves and branches of *Quercux ilex*, 25-I-1983, *J.L. Siquier*, H.AH 10937.

Didymium bahiense Gottsberger em. Nann.-Brem.
MADRID: Alcalá de Henares (Quinta Cervantes), on spike of *Zea mays*, 9-XI-1987, *C. Illana*, H.AH 10945.



Figs. 21-24.- *Didymium karstensii*: Sporocysts and spores (H.AH 10999)

Didymium clavus (Alb. & Schwein.) Rabenh.

SEGOVIA: Mountain pass of Los Leones, on a dead branch of *Santolina rosmarinifolia*, 8-IV-1984, *G. Moreno*, H.AH 10926.

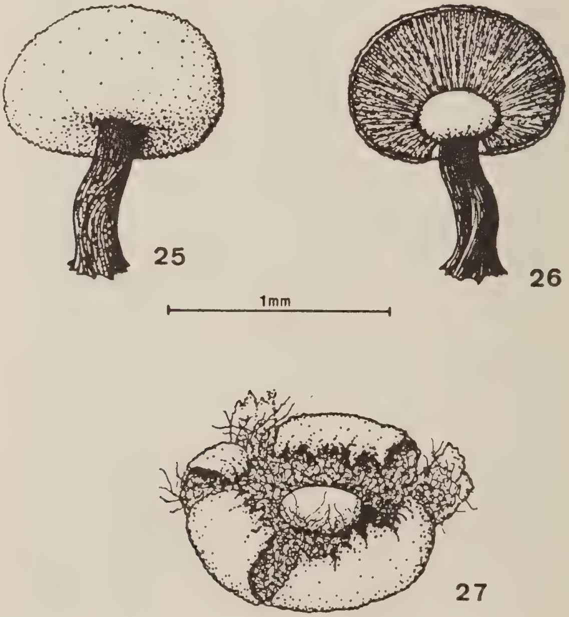
Didymium difforme (Pers.) Gray
MADRID: Alcalá de Henares (Quinta Cervantes), on stems of *Althaea rosea*, 15-XII-1983, *C. Illana*, H.AH 10919. Alcalá de Henares (Quinta Cervantes), on dead wood of *Cercis siliquastrum*, 13-V-1988, *C. Illana*, H.AH 11030.

Didymium karstensii Nann.-Brem. (Fig. 21-24)
MADRID: Alcalá de Henares (Finca La Oruga), on leaves of *Populus alba*, 7-V-1988, *F. Esteve-Raventós & C. Illana*, H.AH 10999.

Comments: This species is characterized by its sessile whitish to greyish-whitish sporocysts with a tipically wrinkled-rugose double (at least below) peridium. The spores are subglobose, 10-12 µm diam., and their ornamentation agrees exactly with the one described by NANNENGA-BREMEKAMP (1974).

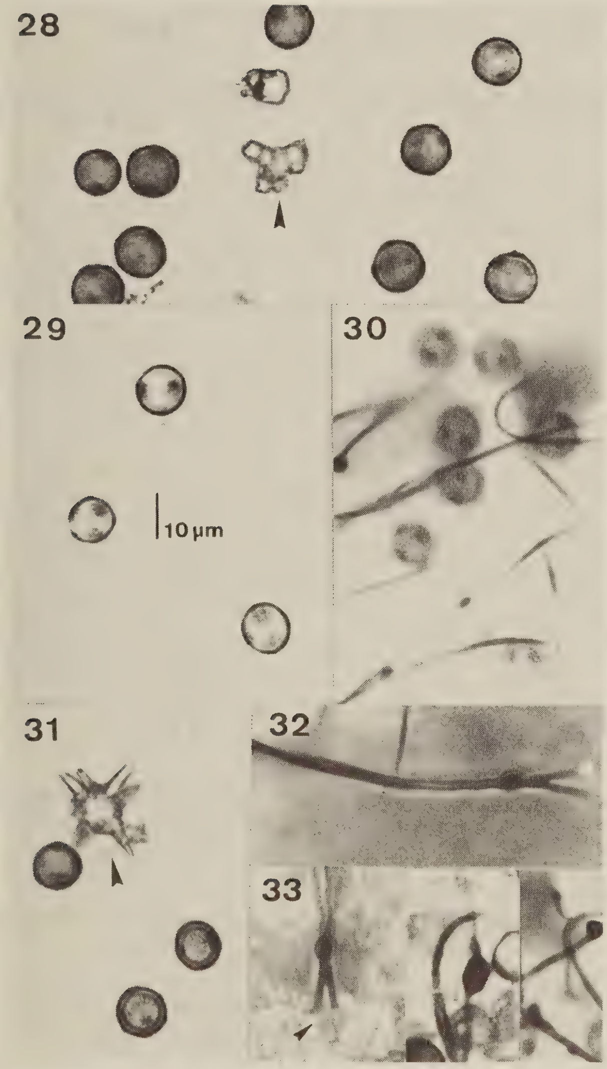
This is a new contribution to the national catalogue of *Myxomycetes*.

Didymium marineri Moreno, Heykoop & Illana, **sp. nov.** (Fig. 25-33)
Etymology: in honor of Prof. Sebastián Mariner-Bigorra, who died recently and collaborated with us during fifteen years making several latin diagnosis.



Figs. 25-27.- *Didymium marineri*: Sporocysts (Holotypus)

Sporangia 0,4-1 mm diam., globosa, stipitata, albo-cinericia.


28
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10 µm
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Figs. 28-33.- *Didymium marineri*: Spores and capillitium (Holotypus)

Columella convexa et alba. Stipes 0,4-0,7 mm longus, brunneo-ruber.

Sporae sphaericae 9-10 µm diam., fortiter verrucosae aliquibus zonis obscurioribus. Capillitium 1-2 µm diam., aut hyalinum aut pallide luteo-brunneum, nodulis irregularibus et dichotomice desinens. Peridium calcis crystallis aggregatis constitutum. Plasmodium ignotum.

Habitat: in truncis Phoenicis canariensis, Oropesa del Mar (Castellón), 19-IV-1987, *leg.* G. Moreno, *Holotypus* H.AH 11040.

Sporocysts deeply umbilicate below at their union to the stipe, 0,4-1mm diam., scattered to gregarious. Peridium granulose, whitish from the abundant white lime crystals on it, with irregular and generally apical dehiscence. Columella whitish variable, often flat or convex, rarely globose. Stipe 0,4-0,7 mm long, reddish-brown, paler at the apex and without lime crystals. Plasmodium not observed.

Spores brown in mass, 9-10 µm diam., spherical and densely warted with a well defined darker zone. Capillitium hyaline to pale yellowish-brown, 1-2 µm diam., with some irregular nodes, branched dichotomously, united to the peridium in part with some expanded tips.

Habitat: on rests of petioles (still on the stem) of *Phoenix canariensis*, Oropesa del Mar (Castellón), 3-I-1984, *G. Moreno*, HAH 11014 y 11015. Ibidem, 4-I-1984, HAH 11041. Ibidem, 19-IV-1987, *Holotypus* H.AH 11040. (Collected on several palm-trees very distant from each other, from different gardens of this locality). Paratype in the private herbarium of Nannenga-Bremekamp sub nº 16.066, and in MA-fungi.

Comments: *Didymium marineri* is characterized by its well defined whitish convex columella and by its warted spores (9-10 µm diam.) with a darker zone. This species is similar macroscopically to *D. squamulosum* (Alb. & Schwein.) Fr. which differs in its typically whitish and corrugated strongly calcareous stipe. *D. minus* (Lister) Morgan and *D. melanospermum* (Pers.) T. Macbride are different because they have a brown to dark brown, and not whitish, columella and peridium. *D. bahiense* Gottsberger *em.* Nann.-Brem. can be segregated by its long stipes which are 2 to 3 times longer than the diameter of the sporocyst, and by its slightly bigger spores (9)10-12(14,5) µm, NANNENGA-BREMEKAMP (1974).

Didymium melanospermum (Pers.) T. Macbride

MADRID: Montejo de la Sierra, on a branch of *Pinus sylvestris*, 15-IV-1983, *G. Moreno*, H.AH 11004. Mountain pass of la Quesera, on dead leaf of *Fagus sylvatica*, 31-X-1986, *G. Moreno*, H.AH 11000.

Didymium minus (Lister) Morgan

BURGOS: San Juan del Monte, on humus of *Quercus rotundifolia, Pinus halepensis* and *Cistus sp.*, 9-X-1987, *F. Esteve-Raventós*, H.AH 11042.

Didymium squamulosum (Alb. & Schwein.) Fr.

MADRID: Montejo de la Sierra, on leaves of *Salix* sp., 10-X-1987, *G. Moreno*, H.AH 10997. Miraflores de la Sierra, on leaves of *Ulmus minor*, 8-X-1984, *G. Moreno*, H.AH 11003. Alcalá de Henares (Quinta Cervantes), on dried *Poaceae*, 9-XI-1987, *C. Illana*, H.AH 10942. Ibidem, on fruit of *Cercis siliquastrum* and leaves of *Ulmus minor*, 17-XI-1987, H.AH 10943. Ibidem, on dried *Poaceae*, 18-VI-88, *C. Illana*, H.AH 11017. Ibidem, 15-V-1988, *C. Illana*, H.AH 11018. Ibidem, on needles of *Pinus pinea* and fruits of *Cercis siliquastrum*, 17-XI-1987, *C. Illana*, H.AH 11019. Robregordo (Mountain pass of

Somosierra), on leaves of *Betula fontqueri*, 1-X-1986, *R. Galán, F. Esteve-Raventós & G. Moreno*, H.AH 11016

Didymium vaccinum (Durieu & Mont.) Buchet
MADRID: Alcalá de Henares (Quinta Cervantes), on spike of *Zea mays*, 9-XI-1987, *C. Illana*, H.AH 10946. Ibidem, 17-XI-1987, H.AH 10948.

Enteridium lycoperdon Bull.
GRANADA: Sierra Nevada, on a stem of *Salix* sp., 1-VI-1982, *G. Moreno, M. Peinado & J.M. Losa-Quintana*, H.AH 10921.

Fuligo septica (L.) Wigg.
MADRID: Alcalá de Henares, (Finca La Oruga), on a stump of *Populus alba*, 14-V-1988, *M.D. Hedo, E. Galera & C. Illana*, H.AH 11037.
AVILA: Casavieja, on a stem and needles of *Pinus pinaster*, 4-VI-1988, *B. Fransesch & C. Illana*, H.AH 11026, 11027 and 11029.
SEGOVIA: Mountain pass of la Quesera, on dead wood of *Fagus sylvatica*, 16-IX-1982, *G. Moreno*, H.AH 11025.

Leocarpus fragilis (Dickson) Rostaf.
MALLORCA: Road from LLuch to Saller, on humus of *Quercus ilex*, 25-I-1983, *J.L. Siquier*, H.AH 10925.

Licea minima Fr.
ASTURIAS: Cangas de Narcea (Reserva Biológica de Muniellos), on the fruit-body hymenophore of *Piptoporus betulinus*, 5-I-1983, *M.J. Martínez*, H.AH 10911.

Lycogala flavofuscum (Ehrenb.) Rostaf.
MADRID: Alcalá de Henares (Finca La Oruga), on a stump of *Populus alba*, among leaves, 31-X-1987, *C. Illana*, H.AH 10944.

Lycogala epidendrum L.
AVILA: Casavieja, on a cut branch of *Pinus pinaster*, 4-VI-1988, *B. Fransesch, P. Sánchez & C. Illana*, H.AH 11035.
MADRID: Somosierra, on dead wood of *Corylus avellana*, 24-VI-1988, *C. Illana, G. Moreno & F. Esteve-Raventós*, H.AH 11024.

Mucilago crustacea Wigg.
GUADALAJARA: Tamajón (Ermita de los enebrales), on *Thymus vulgaris*, 1-X-1984, *G. Moreno*, H.AH 10936. Chiloeches, on rests of *Poaceae* under *Populus alba*, 26-XI-1987, *E. Rielo*, H.AH 10949.
MADRID: Alcalá de Henares (Cuesta Zulema), on needles of *Pinus halepensis*, 22-XI-1987, *C. Illana*, H.AH 10941. Somosierra, on dead wood of a broad-leaved tree, 24-VI-1988, *C. Illana, G. Moreno & F. Esteve-Raventós*, H.AH 11028.

Physarum cinereum (Batsch) Pers.
MADRID: Alcalá de Henares (Quinta Cervantes), on *Poaceae, 17-XI-1987, C. Illana*, H.AH 11031

Physarum compressum Alb. & Schwein.
CASTELLÓN: Oropesa del Mar, on rests of dried leaves (still on the stem) of *Phoenix canariensis*, 28-XII-81, *G. Moreno*, H.AH 10920.
MADRID: Alcalá de Henares, on a dead leaf of broad-leaved tree, 15-V-1988, C. Illana, H.AH 11011.

Physarum leucophaeum Fr.

MADRID: Mountain pass of Canencia, on a stump of *Betula alba*, 8-XII-1983, *G. Moreno & F. Esteve-Raventós*, H.AH 10914, 10917, 10918 and 10927. Ibidem, on dried rests of herbaceous plants and on leaves and fruits of *Cystus laurifolius*, H.AH 10928.

Physarum nutans Pers.

ÁVILA: Casavieja, on *Polyporus sp.* on *Quercus suber*, 4-VI-1988, *B. Fransesch & C. Illana*, H.AH 11039. Montejo de la Sierra, on wood of *Quercus pyrenaica*, 24-VI-1988, *C. Illana, G. Moreno & F. Esteve-Raventós*, H.AH 11022. Mountain pass of Somosierra, on bark of a dead branch of *Betula alba*, 24-VI-1988, *C. Illana, G. Moreno & F. Esteve-Raventós*, H.AH 11021.

Physarum pezizoideum (Jungh.) Pav. & Lag. var. **microsporum** Farr

GUADALAJARA: Valfermoso de Tajuña, on carpophores of *Auricularia mesenterica*, 10-XI-1985, *T. Martín*, H.AH 10910.

Only known in Spain from one other collection from the province of Madrid, (NANNENGA-BREMEKAMP & LADO, 1985).

Physarum pusillum (Berk. & Curt.) G. Lister

MADRID: Alcalá de Henares (Quinta Cervantes), on *Poaceae, 17-XI-1987, C. Illana*, H.AH 10950. Ibidem, on a dead leaf of *Iris germanica*, H.AH 10951.

Physarum straminipes Lister

CASTELLÓN: Oropesa del mar, on rests of *Phoenix canariensis*, 3-I-1984, G. Moreno, H.AH 11014 and 11015.

MADRID: Alcalá de Henares (Quinta Cervantes), on a stem of *Ailanthus altissima*, 21-I-1988, *C. Illana*, H.AH 11010.

Physarum vernum Sommerf.

CASTELLÓN: Oropesa del Mar, on a dried stem of *Phoenix canariensis*, 2-IV-1988, *G. Moreno*, H.AH 10923.

MADRID: Alcalá de Henares (Quinta Cervantes), on branches of *Ailanthus altissima*, 17-XI-1987, *C. Illana*, H.AH 10939.

Stemonitis fusca Roth

CIUDAD REAL: Sierra de Riofrío, on leaves of *Betula parvibracteata*, 11-VI-1982, *G. Moreno, M. Peinado & A. Velasco*, H.AH 10924..

Stemonitis virginiensis Rex

GUADALAJARA: Embalse de El Vado, on a branch of *Pinus pinaster*, 4-IV-1981, *G. Moreno & J.L. Manjón*, H.AH 10998 and 11001.

CIUDAD REAL: Sierra de Riofrío, on trunk wood of *Betula parvibracteata*, 15-VII-1982, *G. Moreno, S. Rivas-Martínez & Peinado*, H.AH 10912 and 10913.

Symphytocarpus flaccidus (Lister) Ing & Nann.-Brem.

AVILA: Casavieja, on piled branches of *Pinus pinaster*, 4-VI-1988, *P. Sánchez, B. Fransesch & C. Illana*, H.AH 11043.

Trichia varia (Pers.) Pers.

MADRID: Mountain pass of Canencia, on a stump of *Betula alba*, 10-X-1984, *G. Moreno & F. Esteve-Raventós*, H.AH 10940. Montejo de la Sierra, on woody rests of *Fagus sylvatica*, 15-IV-1983, G. Moreno, H.AH 11034.

Tubifera ferruginosa (Batsch) J.F. Gmelin

SEGOVIA: Nacimiento del río Moros, on stump and needles of *Pinus sylvestris*, 1-VII-1987, *G. Moreno & F. Esteve-Raventós*, H.AH 10424, 10425, 10426 and 10426.

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A NEW OPHIOSTOMA ON POLYPORES

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Abstract. Ophiostoma polyporicola n. sp., is described from several collections on polypores from Sweden and Finland. Both a Sporothrix anamorph and the teleomorph were obtained in cultures initiated from ascospores.

Two polypores, Fomitopsis pinicola and Tyromyces stipticus, colonized by an Ophiostoma, were collected several times in Sweden and once in Finland over the years. Cultures obtained from the ascospores of two recently collected specimens produced a Sporothrix anamorph. This fungus differs from the known species of Ophiostoma by a number of characters and is here described as new.

Cultures were initiated by inoculating ascospores collected in droplets at the tip of the ascoma neck on malt extract agar (2% malt extract and 1.5% agar per litre) on a modified malt agar according to Upadhyay (1981) and on oatmeal agar. Cultures were incubated at 20-22°C in darkness for 5 days followed by up to 30 days incubation at the same temperature under near ultraviolet and cool daylight on a regime of 12 h.

Ophiostoma polyporicola O. Const. & Ryman, sp. nov. - Figs 1, 2.

Ascomata solitaria vel caespitosa; basis nigra, globosa, laevis, 200-300 µm diam.; rostrum nigrum, 750-2250 µm longum, ad basim 45-75 µm, ad apicem 17-30 µm latum; hyphae ostiolares absentes. Asci non visi. Ascosporae hyalinae, aseptatae, lunatae, utrinque rotundatae, 3-3.5 x 1-1.3 µm; vagina gelatinosa egentes.

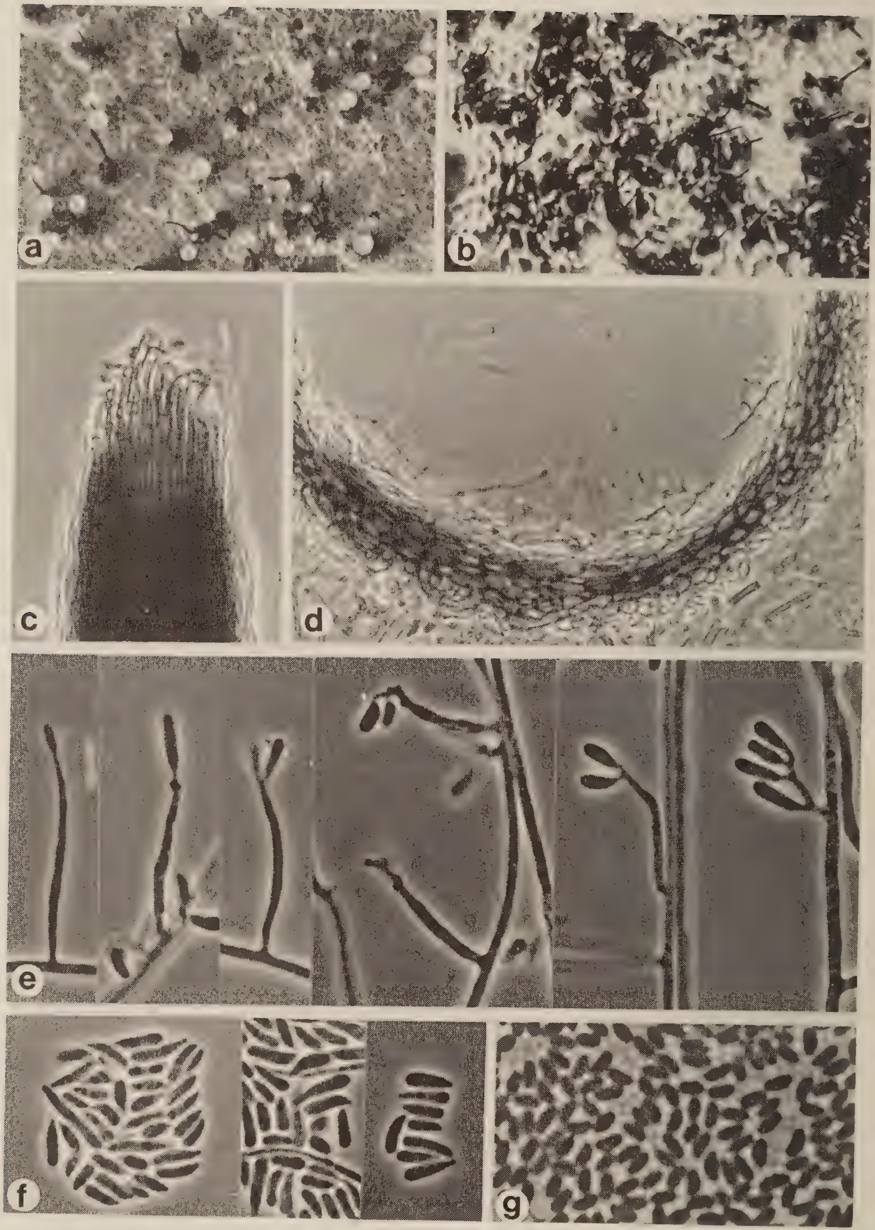

Fig. 1. Ophiostoma polyporicola. a. Ascomata in culture; b. ascomata on Tyromyces stipticus (S. Ryman 6102, photo I. Holmåsen); c. ascoma neck; d. sectioned ascoma wall; e. conidiogenous cells and conidia; f. conidia; g. ascospores from culture. (a, c-g from UPSC 1704).

Anamorphosis ad genus Sporothrix pertinens. Cellulae conidiogenae hyalinae, continuae, 10-40 x 1-2 µm; conidia hyalina, laevia, clavata, plus minusve curvata, ad basim truncata, 6-14 x 2-2.5 µm.

Holotype: on Fomitopsis pinicola, Sweden, Uppland: Vänge par., Fiby urskog, 13 Sept. 1985, S. Ryman 8069 (UPS). Living culture ex type: UPSC 1704 = CBS 669.88.

Mycelium not apparent. **Ascomata** single or in groups on the basidiocarps of the hosts, mostly immersed in the tubes or sitting at the pore surface, but also on the tissues surrounding the pores; base black, globose, smooth, 200-300 µm diam; wall 15-25 µm thick, composed of an outer layer of 2-3, brown, thick-walled, irregularly shaped cells, 4-10 µm diam, and an inner layer of 1-2, paler and more thin-walled cells; neck black, 750-2250 µm long, 45-75 µm wide at the base, gradually tapering to 17-30 µm at the tip, occasionally with 1(-2) swellings and often with a subapical constricted ring; neck composed of parallel, 2-3 µm wide

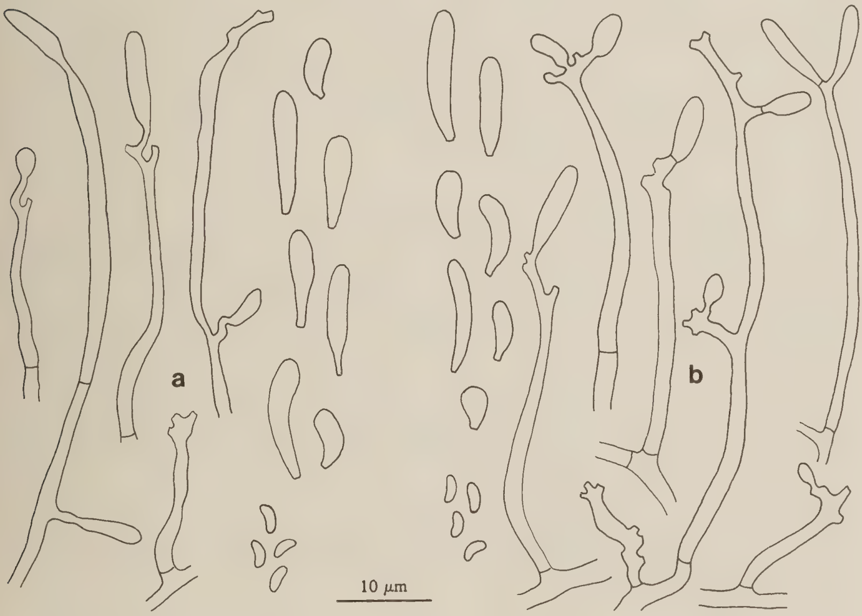

Fig. 2. Ophiostoma polyporicola. Conidiogenous cells, conidia and ascospores from culture. a. from UPSC 1704; b. from UPSC 2355.

hyphae, brown or dark-brown and with various thickenings of the walls at the base of the neck but paler and smoother toward the tip; ostiolar hyphae absent. **Asci** evanescent, not seen. **Ascospores** hyaline, 1-celled, lunate with rounded ends in side view, 3-3.5 x 1-1.3 µm, without gelatinous sheath, collecting in a milky droplet at the tip of the neck. Scattered conidia and a few conidiophores and conidia similar to those obtained in culture (described below) were noticed in three specimens.

Colonies attaining a diameter of 17-18 mm after 12 days and 36-45 mm after 30 days, at first smooth but later covered with radially oriented hyphal strands or synnema-like structures, ochreous; margin submerged, fimbriate; exudate and diffusible pigment absent; reverse with a yellowish tinge. Submerged advancing **hyphae** 1-1.5 µm wide, older hyphae up to 2.5 µm. **Conidiogenous cells** arising from undifferentiated hyphae, continuous, 10-40 µm long, 1-2 µm wide, slightly tapering towards the tip, with several terminal and intercalary, 1-2 µm long and 0.5-1 µm wide conidium-bearing denticles; conidiiferous part sometimes slightly inflated. **Conidia** hyaline, smooth and thin-walled, clavate, more or less curved, 6-14 x 2-2.5 µm, base truncate, c. 1 µm wide. Ascomata and ascospores morphologically similar to those occurring on the natural substratum are formed after 25-30 days on 2% malt extract agar, and to a lesser extent on oatmeal agar.

OTHER MATERIAL EXAMINED (all in UPS).

On Fomitopsis pinicola. FINLAND: Kuusamo: Kuusamo par., 5 km NE of Ruka, 26 Aug. 1978, N. Lundqvist 11786; SWEDEN: Småland: Värnamo, Kävsjö, 13 July 1987, O. Constantinescu & W. Gams (UPSC 2355 = CBS 670.88, living culture); Västmanland: Ängsö par., close to the castle of Ängsö, 21 May 1969, R. Santesson 21171b; Gästrikland: Gävle, Vallshage, 11 Oct. 1969, J. A. Nannfeldt 20712b; Ångermanland: Nordingrå par., Villmyran Nature Reserve, 17 June 1982, N. Lundqvist 13782.
On Tyromyces stipticus. SWEDEN: Uppland: Stockholm, 4 Nov. 1894, L. Romell; Uppland: Vänge par., Fiby urskog, 3 Oct. 1980, S. Ryman 6102.

DISCUSSION

Having short, lunate ascospores with rounded ends, deprived of a gelatinous sheath, Ophiostoma polyporicola should be placed in the Pilifera group of Ceratocystis (Olchowecki &

Reid 1974), or in the section Ophiostoma of the same genus (Upadhyay 1981). However, by consistently forming a Sporothrix anamorph in culture, its place is in Ophiostoma as defined by de Hoog 1974, Weijman & de Hoog 1975, Samuels & Müller 1979 and de Hoog & Scheffer 1984.

There are three species of Ophiostoma having some resemblance with O. polyporicola: O. epigloeum (Guerrero) de Hoog differs by smaller ascomata with shorter neck and straight and shorter conidia, O. angusticollis Wright & Griffin has a faster growth rate, smaller ascomata with narrower neck, reniform ascospores and much smaller conidia, and O. nigrocarpum (Davis) de Hoog has a faster growth rate, much smaller ascomata and smaller, straight conidia.

The anamorph of O. polyporicola should be compared with other Sporothrix species having clavate, more or less curved conidia with truncate base. Only Sporothrix curviconia de Hoog has some resemblance with our fungus, but it has a slower growth and smaller conidia. In addition, S. curviconia has a second type of lateral, guttuliform conidia, lacks a teleomorph and is of tropical origin.

Most species of Ophiostoma are saprophytic on wood, a few are parasitic, and only occasionally they are found on other substrata (Upadhyay 1981). Only three species have been described from fungi: O. epigloeum (Guerrero) de Hoog (1974) on Tremella fuciformis, and O. roraimense and O. grande, these last described by Samuels & Müller (1979) from stromata of Diatrype. All three differ from O. polyporicola in the characters of both the telomorph and the anamorph. Griffin (1968) found an Ophiostoma on Fomitopsis pinicola in Canada and considered it identical with Ceratocystis perparvispora Hunt, now known as Ophiostoma microsporum (Davids.) v. Arx. The examination of this specimen (SSMF 755-8126-01 = MFB 7405) showed that it fits O. microsporum indeed, but the conidial state on the accompanying dried culture, described by Griffin l.c. as ´conidia abundant, produced directly on the mycelium´ is Acremonium olidum W. Gams (1971). Two living cultures of Ophiostoma microsporum (CBS 315.77 and 440.69) were also compared with our fungus. These strains showed a superficial resemblence with O. polyporicola regarding the culture characteristics, but they produce broader ascospores and typically reniform conidia, as depicted by De Hoog (1974) and Maekawa et al. (1987).

Ophiostoma polyporicola is often associated with Acremonium olidum W. Gams and Hypocrea pulvinata Fuckel. Gams (1971) mentioned this association when he described Acremonium olidum from a polyporaceous fruitbody. Moreover, he noticed the presence of an Ophiostoma (Ceratocystis) in the type specimen.

Acknowledgements. We thank the Curator of CBS for providing two strains of Ophiostoma microsporum, Dr. D. T. Myren for the loan of Ceratocystis perparvispora, Mrs Ulla-Britt Sahlström for photographic assistance, and Mr I. Holmåsen for providing the photograph used as fig. 1 b. Drs W. Gams and G. S. de Hoog critically reviewed the manuscript. The senior author gratefully acknowledges the financial support of the Swedish Natural Science Research Council and the Swedish Council for Forestry and Agricultural Research.

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LITHOGRAPHA, A LICHEN GENUS NEW TO CONTINENTAL NORTH AMERICA

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During the summers of 1978, 1979, and 1980 the author made extensive collections of the lichens of Cape Prince of Wales on the tip of the Seward Peninsula at the Bering Strait in Alaska. Among the crustose lichens collected on dark grey, fine-grained schist inland from the coast was an interesting lichen with lirellate apothecia and a grey areolate thallus. The lichen has been identified as *Lithographa tesserata* which has been reported for Sweden, England, Wales, Germany, Austria, Italy, and Rumania by Redinger (1937); in the Arctic and Caucasus of the U.S.S.R. by Kopaczevskaja et al. (1977); and the Narssaq District of Greenland by Alstrup (1979). Neither the genus or the species has been reported for Continental United States or Canada in the *Fifth Checklist of Lichens* (Egan, 1987). Dr. W.A. Weber of the University of Colorado Herbarium agrees with the identification, and Dr. John W. Thomson of the University of Wisconsin confirms that the genus and species have not previously been reported for the Alaskan-Canadian Arctic.

The species is very distinctive and easily recognized but may not be spotted without the aid of a hand lens. The Alaskan specimen covered only a small area and did not stand out against the dark substrate. The species may be restricted to extreme western Alaska, but it may also have a wider distribution over the Continental United States and Canada and been overlooked. The following descriptions of the genus and species are presented with the hope that other lichenologists will look for the species and enhance the possibility that it might be found elsewhere in the Continental United States and Canada.

The following descriptions have been provided by Dr. Thompson:

Lithographa Nyl.

Acta Soc. Linn. Bordeaux 21:393. 1856. *Placographa* Th. Fr. Gen. Heterolich. 95. 1861.

Thallus crustose, finely granulose to warty or areolate. Apothecia round to elongate with open slit-like disk or widening; exciple black; paraphyses branched, often gelatinizing; asci clavate; spores 8 or many, simple, hyaline, ellipsoid. Algae *Pleurococcus*.

Lithographa tesserata (DC.) Nyl.

Acta Soc. Linn. Bordeaux 21:441. 1856. *Opegrapha tesserata* DC., in Lam. & DC., Flor. Franc. 3:313. 1805. *Placographa tesserata* Th. Fr., Lich. Scand. 1:636. 1874.

Thallus thick, granular, warty or smooth to chinky areolate with angular 1 mm broad areoles, or with rounded raised portions with a black hypothallus, the areoles pale to dark brown or whitish gray, dull, K+ yellow becoming red, C-, the hypothallus present in var. *petraea* (Ach.) Redinger, absent or nearly so in var. *nivalis* (Th. Fr.) Zahlbr. Apothecia dispersed, slightly projecting over the areoles; with the base narrowed and the upper edges sickle-like and slit-like turned inwards making the mouth nearly closed; the exciple thick, black; a thin dark brown epithecium is granulose; the hymenium hyaline to brownish, not inspersed, I+ blue; paraphyses slender, non-capitate, nearly unbranched; asci clavate; spores 8, uniseriate to biseriate, ellipsoid to ovate, simple, hyaline, 9-15 x 5-8 micrometers.

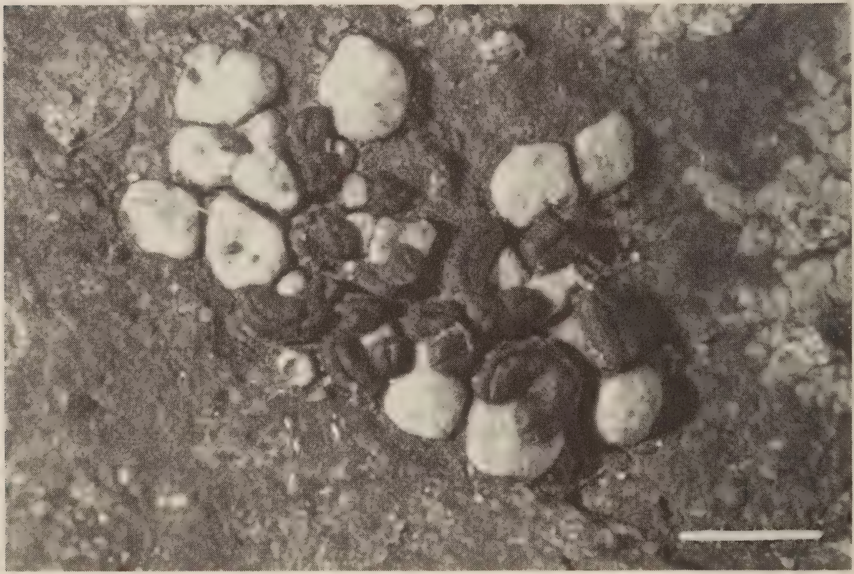

Fig. 1. *Lithographa tesserata* (DC.) Nyl.
(COLO L-83471). Bar = 1 mm.

Acknowledgments

I wish to thank Dr. W. A. Weber for confirmation of the identification of *Lithographa tesserata* and Dr. John W. Thomson for confirmation of the new record for the genus and species for the North American Arctic and for the English translation of the genus and species descriptions. Photographic work was supported in part by BRSG Grant RR07013-16 awarded to the Department of Molecular, Cellular, and Developmental Biology, University of Colorado, Boulder by the Biomedical Research Grant Program, Division of Research Resources, National Institutes of Health. The Bering Strait study was sponsored by the Museum, University of Colorado, Boulder.

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MYCOTAXON

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NOTES ON ONE LICHENICOLOUS AND ONE FUNGICOLOUS DISCOMYCETE

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1. A New Combination for a *Skyttea* on *Lecanora effusa.*

In connection with the study on *Unguiculariopsis thallophila* (Karst.) Zhuang (1988), which is on *Lecanora carpinea,* the description of another interesting lichenicolous discomycete, *Mollisia lesdainii* (Vouaux in Bouly de Lesd.) Vouaux (1914), drew our attention; this was also reported on a *Lecanora, L. effusa.* The morphological characteristics described by the original author are similar to those of *U. thallophila.* To discover whether both names refer to the same fungus was our original purpose.

First published as a lichen, *Nesolechia lesdainii* Vouaux in Bouly de Lesdain (1910), the fungus was later transferred to *Mollisia* as *M. lesdainii* (Vouaux, 1914). It was collected by Bouly de Lesdain on *Lecanora effusa* on *Salix* sp. in Dunkerque, France. The name later appeared in a list of Vouaux's fungal parasites of lichens prepared by Prof. Y. Rondon (1970). In order to locate the type specimen of this fungus the junior author contacted Dr. D. L. Hawksworth in England and Dr. J. Astier in Marseilles, France, for Prof. Rondon's office and home addresses. We were then able to write Prof. Rondon, but unfortunately received no answer. Through the continuing help of Dr. J. Astier we finally received the type specimen two years later. Although the senior author has published her monographic study on the genus *Unguiculariopsis* we think that it is worthwhile to prepare a note on the taxonomic position of this rare fungus because it was very difficult to locate the type specimen and because perhaps no attention will be paid to the fungus otherwise.

Our type examinations of *M. lesdainii* and of *U. thallophila* indicate that both fungi are similar in the shape of asci and of ascospores and in possessing brown ectal excipular cells forming an ectal excipulum of textura angularis. But *M. lesdainii* is different from *U. thallophila* in having urceolate apothecia submerged in the lichen thalli instead of having cupulate apothecia which are superficial at maturity; in possessing very few hair-like cells which are short, straight, slightly tapered towards the apex, and distributed only on the inner face of the margin ("summit"), instead of possessing well-developed hairs with a fine, hooked apex and a swollen base distributed both at the margin and on the flanks; in possessing ectal excipular cells not loosely interconnected and with ectal excipular tissues slightly gelatinized, instead of loosely interconnected cells and non-gelatinized tissues.

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Sherwood et al. (1980) published the genus *Skyttea* to accommodate a small group of lichenicolous discomycetes which have small, urceolate, immersed, dark brown or olive green, non-carbonized apothecia, small-celled, pseudoparenchymatic ectal excipulum, with hyaline to brown, thin-walled, smooth hairs on the inner face of the margin, filiform paraphyses, thick-walled, J– asci with the apex thickened, and 0-3-septate ascospores. *Mollisia lesdainii* possesses many features of *Skyttea* except for the morphology of the ascus apex which is not obviously thickened. But the ascus morphology is similar to that of *Skyttea cruciata* Sherwood et al. We think that *M. lesdainii* fits *Skyttea* better than any other genus and transfer this fungus to *Skyttea.* In passing, it should be noted that Sherwood et al. (1980) had referred *Unguiculariopsis thallophila* to *Skyttea*, which the senior author later transferred to *Unguiculariopsis* (Zhuang, 1988).

Mollisia lesdainii differs from the somewhat similar *S. cruciata* in the shorter asci, smaller ascospores, shape and length of marginal "hairs," larger ectal excipular cells, and occurrence on the thalli of *Lecanora effusa* and not on *Diploicia canescens.*

Skyttea lesdainii (Vouaux in Bouly de Lesd.) W.-y. Zhuang & Korf, **comb. nov.** (Fig. 1)

≡ *Nesolechia lesdainii* Vouaux in Bouly de Lesd. (*'lesdaini'*), Rech. Lich. Dunk. p. 272, 1910.

≡ *Mollisia lesdainii* (Vouaux in Bouly de Lesd.) Vouaux (*'lesdaini'*), Bull. Soc. Mycol. France 30: 180, 1914.

Apothecia urceolate when young and cupulate at maturity, submerged in lichen thalli, sessile, solitary or a few in a group, dark brown, 0.1-0.2 mm in diam when dry. Ectal excipulum of textura angularis, 10-20 µm thick, cells brown, subglobose, 5-8(-10) µm in diam, tissue slightly gelatinized, cells on inner face of margin ("summit") elongating to form short hairs or hair-like cells, ca. 10-15 µm long, straight, tapered towards the apex, wall slightly thickened. Medullary excipulum of textura intricata, thin, hyphae subhyaline. Asci inoperculate, 8-spored, clavate, J–

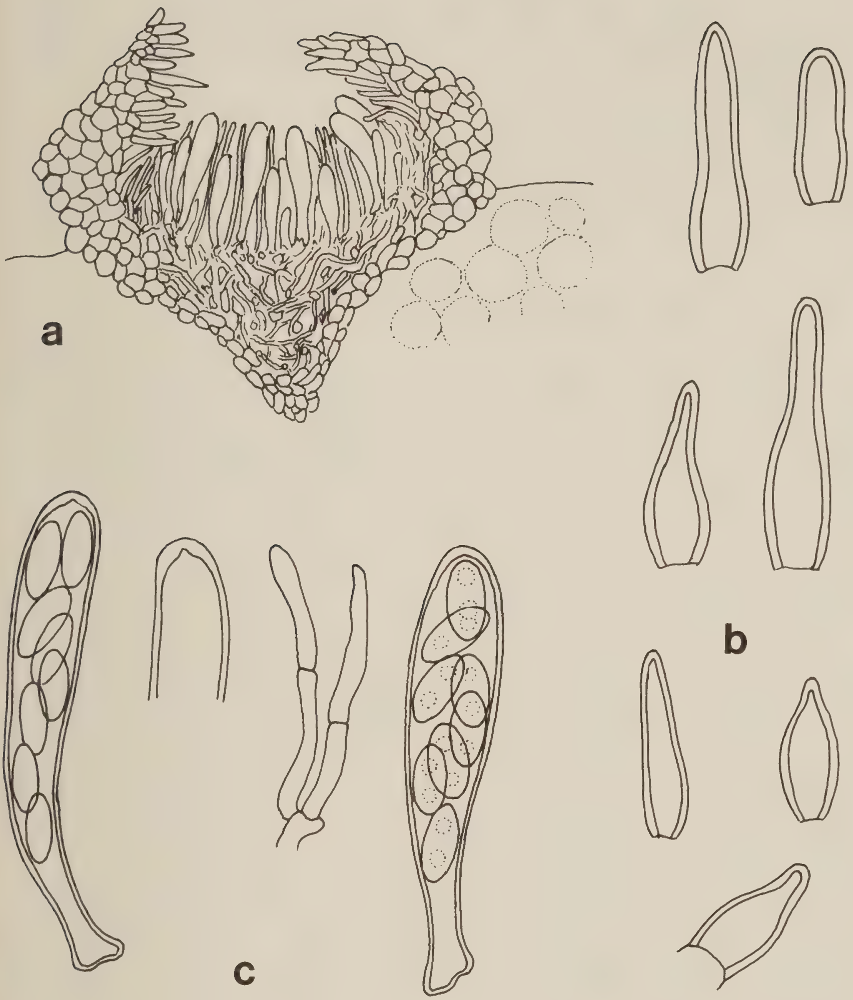


Fig. 1. *Skyttea lesdainii* (holotype): **a**. anatomy of an immersed apothecium on lichen thallus, x 370; **b**. hairs, x 1760; **c**. two asci, an ascus apex and two paraphysis apices, x 1760.

in Melzer's Reagent, walls slightly thickened at apex, 23–35 x 5.7–7 µm, arising from croziers. Ascospores irregularly biseriate, ellipsoid, hyaline, non-septate, biguttulate, 5–7.5 x 1.8–2.2 µm. Paraphyses filiform, septate, not exceeding asci.

On thalli of *Lecanora effusa*.

Holotype examined: on thalli of *Lecanora effusa* on *Salix* sp., Dunkerque, France, Bouly de Lesdain, 23 IX 1903, Vouaux Herbarium, from Prof. Y. Rondon (personal herbarium?), courtesy of Dr. J. Astier.

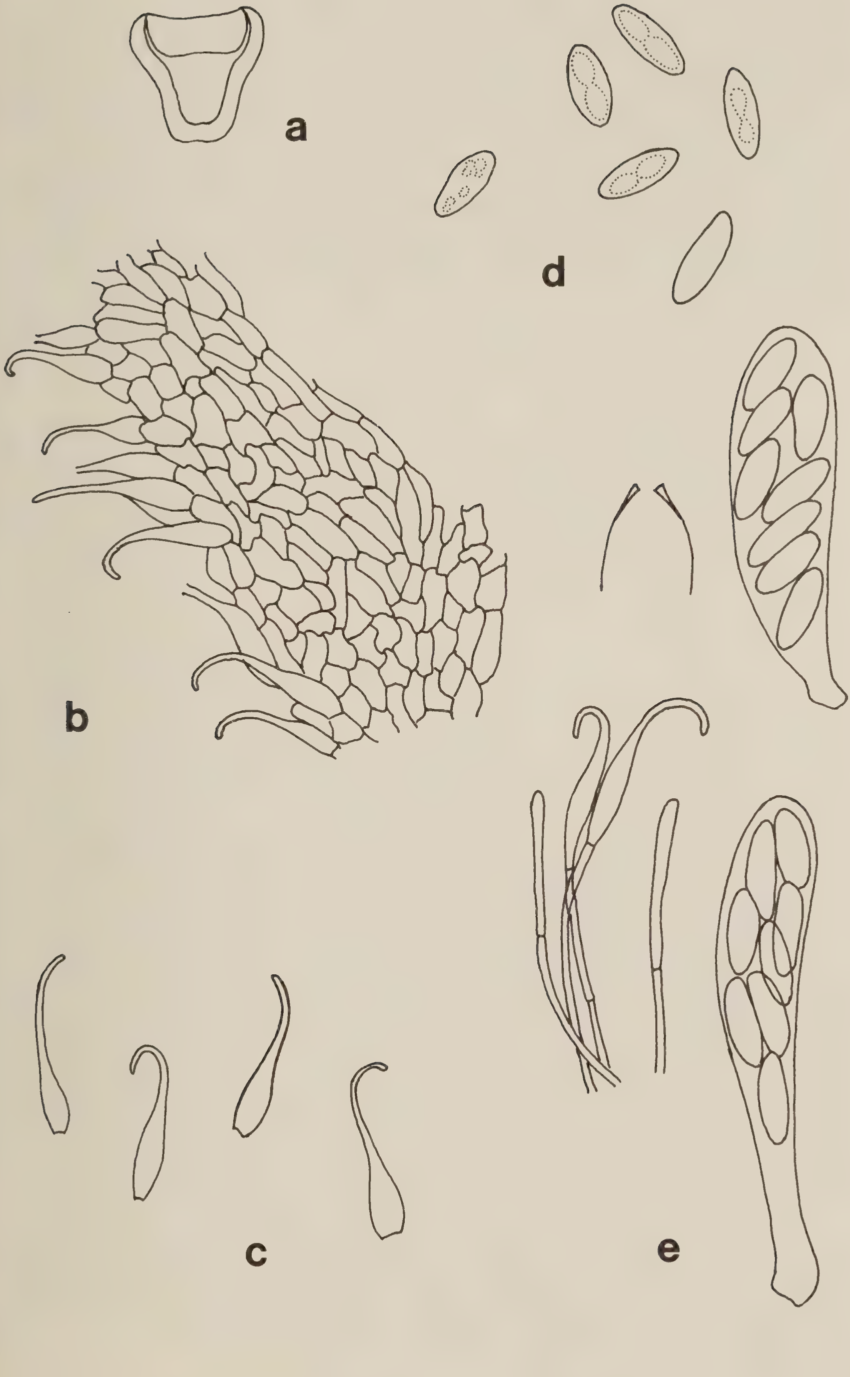
2. A New Species of *Unguiculella* on *Diaporthe* sp.

An interesting discomycete was discovered on the fine beaks of old fruit bodies of a *Diaporthe* species in Jamaica. The apothecia of this fungus are extremely small and not easy to detect with a hand lens in the field. Our laboratory observations show that the receptacle surface of this fungus is covered with short, glassy hairs which are characterized by a swollen base and a fine, hooked apex, that the ectal excipulum is of textura prismatica to textura angularis, and that two kinds of paraphyses are present in the same apothecium, one with a normal apex and the other with a hair-like, elongate, hooked apex.

Judging from the morphology of the Jamaican fungicolous discomycete, *Unguiculariopsis* and *Unguiculella* are genera in which the fungus might possibly be accommodated. The habit on fungi and the hooked hairs fit the characteristics of *Unguiculariopsis,* whereas the excipular structure of textura prismatica to textura angularis and the presence of hair-like, hooked paraphyses are not consistent with the generic concept of *Unguiculariopsis* in which the ectal excipulum is of textura globulosa to textura angularis and the paraphyses are filiform with a normal apex (Raschle, 1977; Korf & Kohn, 1980; Zhuang, 1988). In early drafts of the senior author's monograph of *Unguiculariopsis* (Zhuang, 1988) this species was tentatively placed in that genus. Our later studies indicate that it is better treated as an *Unguiculella.* By error the name *Unguiculariopsis jamaicensis* appeared once in the thesis publication (Zhuang, 1988).

Presence of both hooked hairs and tapering, hooked paraphyses is clearly a diagnostic feature of Höhnel's original concept of *Unguiculella* (Höhnel, 1906). Moreover, a few species of *Unguiculella, U. aggregata* (Feltg.) Höhn., *U. meliolicola* Dennis, and *U. oregonensis* (Kanouse) Dennis, are also reported on fungi (Kanouse, 1941; Dennis 1955; S.

Fig. 2. *Unguiculella jamaicensis* (holotype): **a**. shape of apothecium, from top to bottom showing hymenium, medullary excipulum, and ectal excipulum; **b**. structure of ectal excipulum at flanks; **c**. hairs; **d**. ascospores; **e**. two asci, an ascus apex, and two kinds of paraphyses; **a** x 100, **b-e** x 1300.


a
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Huhtinen, personal communication). The ectal excipular structure of the Jamaican fungus is very similar to these three *Unguiculella* species. Although two kinds of paraphyses have not previously been reported in any species of *Unguiculella,* we think that most features of the Jamaican collection are like *Unguiculella.*

U. oregonensis is possibly the closest species to the Jamaican discomycete. But the Jamaican species can be distinguished from *U. oregonensis* by the much smaller apothecia, which are faintly vinaceous instead of white and cupulate instead of flat to convex when rehydrated, by wider asci and longer ascospores, and by the presence of normal paraphyses in addition to tapered, hooked paraphyses. We treat the fungus as a new species of *Unguiculella.*

Unguiculella jamaicensis W.-y. Zhuang & Korf, **sp. nov.** (Fig. 2)

Ab Unguiculella oregonensi *apotheciis minoribus, ascis latioribus, ascosporis longioribus, et paraphysibus normalibus filiformibus praesentibus una cum paraphysibus gradatim angustatis uncinatis apice, etiam presentia in* Diaporthae *specie differens.*

Apothecia cupulate, sessile to subsessile, 0.1–0.15 mm in diam when fresh; hymenium faintly vinaceous when fresh, receptacle surface furfuraceous, somewhat whitish. Hairs covering the entire receptacle surface, thin- and smooth- walled, with a swollen base and a fine curved apex, pale brown at the base and subhyaline at the apex, not becoming purple in Melzer's Reagent with or without 10% KOH pretreatment, nonseptate, with lumen extending to the apex, 13–23 µm long. Ectal excipulum of textura prismatica to textura angularis, 11–22 µm thick, cells brown, thin-walled. Medullary excipulum of textura intricata, hyphae subhyaline to pale brown. Subhymenium indistinguishable. Asci inoperculate, 8-spored, clavate, J– in Melzer's Reagent, 35–45 x 6.6–8.8 µm. Ascospores biseriate, ellipsoid, hyaline, nonseptate, mostly biguttulate, some multiguttulate, 7.8–10.2 x 3.0–3.5 µm. Paraphyses filiform, septate, some with a normal apex and some with an elongated, tapering, hooked apex, normal paraphyses not exceeding asci and hooked paraphyses exceeding asci, normal paraphyses and the lower part of hooked paraphyses ca. 1 µm wide.

On fruit bodies of an old *Diaporthe* sp.

Holotype: on beak and other superficial parts of fruit bodies of a *Diaporthe* species on a branch, near entrance to Wallingford Coffee Industry Development Co., above St. Peters, St. Andrew Parish, Jamaica, 3750 ft. elev., R. P. Korf, T. Iturriaga, and W.-y. Zhuang, 8. XII. 1986, CUP–MJ 1013.

ACKNOWLEDGEMENTS

We deeply thank Dr. J. Astier, Marseilles, France for locating the type specimen of the lichenicolous discomycete, Dr. W. J. Dress of the Bailey Hortorium, Cornell University for providing the Latin diagnosis, and Dr. G. J. Samuels of the New York Botanical Garden for identifying the host fungus of *Unguiculella jamaicensis*. The junior author gratefully acknowledges financial assistance from the Systematic Mycology and Lichenology Laboratory, Academia Sinica, that made his stay and studies in China in the autumn of 1988 possible.

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NOTEWORTHY CORTICOLOUS LICHENS IN NOTHOFAGUS FORESTS, NORTH-WESTERN PATAGONIA

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SUMMARY

Six corticolous lichens are reported for the first time from Argentina:**Calicium leucochlorum** Tuck.var. **paraguayense** Sant., **Haematomma hilare** Zahlbr., **Hypogymnia pulverata** (Nyl.ex Crombie) Elix, **Leioderma amphibolum** (Knight) Galloway & Jørge., **Leptogium laceroides** B. de Lesd.and **Parmeliella thysanota** (Stirton) Zahlbr. Four of these species show a remarkable disjunct distribution: Southern South America-Australasia

INTRODUCTION

The lichen flora of Argentina in general and that of the Nahuel Huapi National Park in particular has not been well investigated and the available information is very scarce (Grassi,1950a). There are studies on the foliose and fruticose lichens from Tucumán Province (Grassi 1950b, 1953). Specimens collected in the Nahuel Huapi and Los Alerces National Parks were reported by Lamb(1958). Recent contributions to the lichen flora are concerned mainly with the central and NE parts of Argentina (Ferraro, 1986; Osorio, 1987; Adler, 1987).

This paper is part of a more extensive study that aims at improving the knowledge of the lichen flora in the area of NW Patagonia.

MATERIALS AND METHODS

The lichens for this study were collected by the authors. Collection sites, their geographical position and characterization are specified below the description of each species. All specimens are deposited in the Herbarium of the Centro Regional Universitario Bariloche (BCRU),Universidad Nacional del Comahue, Argentina.

The material was examined under a dissecting microscope for habit and morphology. For anatomical studies, sections 10-25 µm thick were prepared using a freezing microtome and examined by light microscope after mounting in water or lactophenol cotton-blue.

STUDY AREA

Collecting sites: The lichens described in this study were collected from the Nahuel Huapi National Park and surroundings, in an area located between 41°02' and 41°14' S latitude and between 71°19' and 71°50' W longitude (Fig. 1,2). The area has typical Andean relief, with glacial lakes at ca.800 m altitude, surrounded by mountains of up to 2400 m above sea level.

Climate: It is characterized as perhumid to humid and microthermal, according to the classification of Thornthwaite (1948). The average annual temperature is 8°C. Average temperature for the warmest month (January) is 17°C and for the coldest (July) it is 3°C. Lowest temperatures vary from -15 to -25°C. These temperatures were measured at 760m alt. Annual average precipitation decreases abruptly from W to E, from 3000mm/year in Puerto Blest to 1400mm/year in Cerro Carbón (Muñoz et al. 1985).

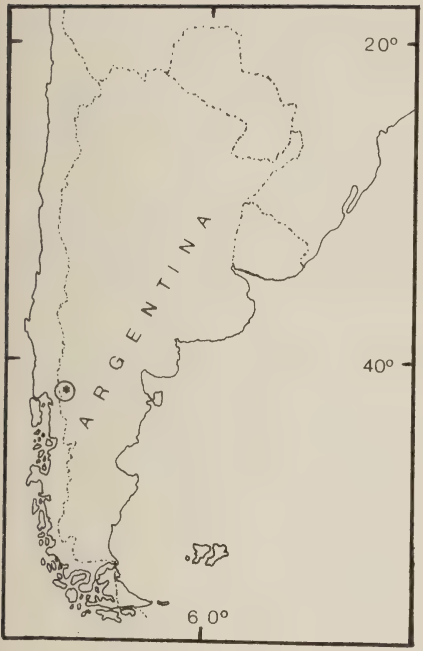
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Fig.1: Southern South America (Nahuel Huapi area ⊙ indicated)

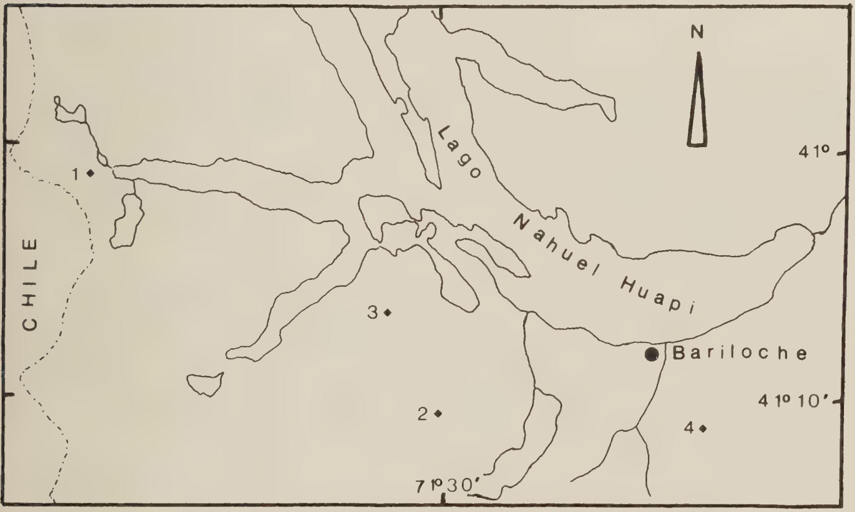
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Fig.2: Collecting sites: 1-Puerto Blest, 2- Cerro Catedral, 3- Cerro López, 4- Cerro Carbón.

-.-.-.- International border

Scale 1: 500.000

Vegetation: Puerto Blest is included in the Valdivian District, with temperate, high, open rainforest, dominated by **Nothofagus dombeyi**, typically with a dense bamboo understory of **Chusquea culeou.** Epiphytes and lianas are common.

The slopes of Cerro López and Cerro Catedral present an altitudinal vegetation gradient, with **Nothofagus dombeyi** open woodlands, frequently in association with **Lomatia hirsuta** and **Austrocedrus chilensis**, from 760 to ca. 1100 m above sea level. At higher altitudes, there are subandine woodlands of deciduous **Nothofagus pumilio** up to the timberline, ca. 1600m above sea level. However, from 1500 m **Nothofagus pumilio** appears as a shrub. Cerro Carbón presents **Nothofagus pumilio** from 1000 to 1500 m alt.

THE LICHEN SPECIES

CALICIUM LEUCOCHLORUM Tuck. var. **PARAGUAYENSE** Sant.(Fig. 3A). Santesson, R. Arkiv för Botanik 30(14): 5. 1943.

Thallus episubstratic, upper surface verrucose, yellow-grey when dry, yellow-green when wet. Verruca 0.3 to 0.8 mm. Forming discontinuous patches.Without soredia.
Apothecia black to brownish-black, 2 to 4 mm high, with very well defined limit between stipe and capitulum. Sometimes with greyish pruina on the lower side of the capitulum. Stipe of constant diam. (to 0.2 mm). Capitulum 0.4 to 0.8 mm diam., 0.5 to 0.8 mm high. Disc plane for young apothecia and convex for mature apothecia. Mazaedium black.
Asci cylindrical to clavate with uniseriate spores. Ascospores 1 or 2-celled, dark brown, 8-15 x 3-5 µm.

Habitat: Found on **Nothofagus pumilio** near the base of the tree in a disturbed forest. Cerro Carbón at 1250 m above sea level.Not frequent.

Specimen examined:Argentina. Parque Nacional

Nahuel Huapi, Cerro Carbón, SW slope,col. Calvelo, 2-V-1987 (BCRU 00022).

Distribution: Paraguay and Argentina.

This is the first record from Argentina.

HAEMATOMMA HILARE Zahlbr. (Fig. 3B).
Zahlbruckner,A. Denkschr. Akad. Wiss. Wein Math. Naturwiss. Kl. 104:350. 1941.

Thallus crustose, whitish, slightly shiny,spread over the substrate with a black line delimiting it. Elongated up to 8 cm. Without soredia. Apothecia lecanorine, sessile, circular, up to 1.5 mm diameter. Disc orange-red, without pruina, surrounded by a thin margin concolorous with the thallus. Epithecium K+, magenta. Ascospores acicular 11-13(-15)-transversely septate,62-70 x 4-5 µm.
The colored apothecia are very conspicuous.

Habitat: Found on young, smooth-barked **Nothofagus dombeyi**, forming circular bands round the trunk, usually in very humid but exposed areas. Puerto Blest at 800 m above sea level.

Specimen examined: Argentina. Parque Nacional Nahuel Huapi, Puerto Blest, path to Cascada Los Cántaros, col. Calvelo, 14-VII-1985 (BCRU 00044).

Distribution: New Zealand and Argentina.

This is the first record outside New Zealand.

HYPOGYMNIA PULVERATA (Nyl.ex Crombie)Elix (Fig. 3C). Elix,J.A.Brunonia 2:217. 1979.
Parmelia mudata var. **pulverata** Nyl.ex Crombie, J.Linn.Soc.Lond. Bot. 15: 395, 1879.

Thallus foliose,heteromerous, 4 to 10 cm diam., laciniae 1 to 5 mm wide, dichotomically branched close together in center and more dispersed peripherally. Upper surface whitish-grey, covered with powdery soredia, especially the older branches. Medulla white, solid. Lower surface black in the center, whitish-brown at the edges.

Apothecia not seen.

Habitat: Found on **Nothofagus dombeyi** near streams in very humid microhabitats. Cerro Catedral at 850 m above sea level.

Specimen examined: Argentina. Parque National Nahuel Huapi, Cerro Catedral, SE slope, col. Calvelo, 10-X-1986 (BCRU 00043).

Distribution: Australasia and Argentina.

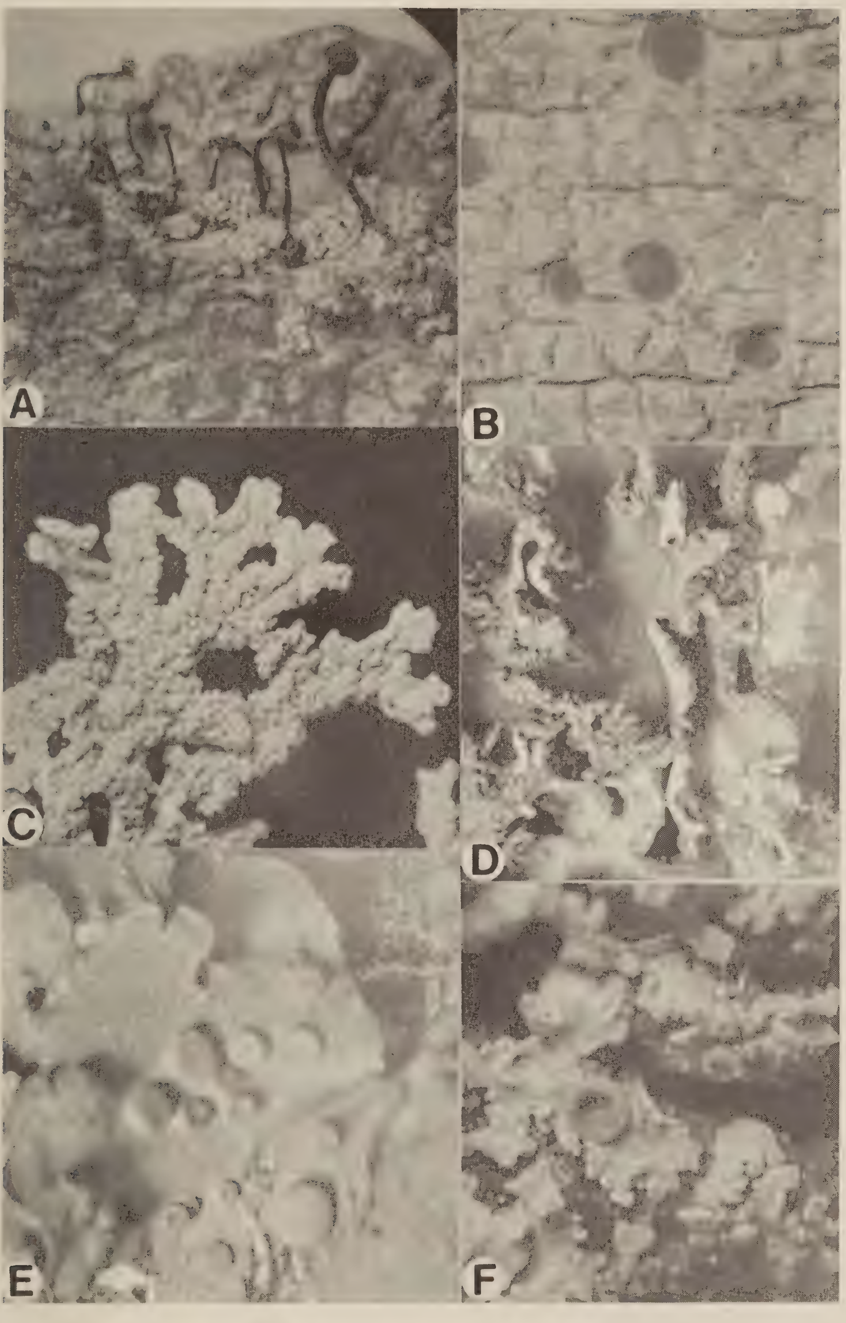
This is the first record outside Australasia.

LEIODERMA AMPHIBOLUM (Knight) Galloway & Jørg. (Fig. 3D).
Galloway,D.J. & P.M. Jørgensen in Kantvilas & James, Lichenologist 19:28.1987.- **Pannaria amphibola** Knight, Trans. N.Z. Inst. 12: 369 . 1880.- **Parmeliella amphibola** (Knight) Müll. Arg., Bull. Herb. Boissier 2 (App. 1): 44 . 1894.-**Pannaria amphibela** Nyl., Lich. Nov. Zel.: 50. 1888.- **Pannularia amphibela** (Nyl.) Hue, Nouv. Archs Mus Hist. nat. Paris sér. 3, 3: 40. 1891.

Thallus foliose, heteromerous, up to 4 cm diam.; lobes 2 to 3 mm wide, irregulary and not very frequently branched, disposed very closely together, sometimes imbricated. Margins undulate, covered with verruciform, granular or coralloid soredia. Upper surface brownish - green when

Fig. 3: Specimens investigated

A **Calicium leucochlorum** Tuck.var.**paraguayense** Sant. (x5)
B **Haematomma hilare** Zahlbr. (x7)
C **Hypogymnia pulverata** (Nyl.ex Crombie) Elix (x4)
D **Leioderma amphibolum** (Knight)Galloway & Jørg. (x4)
E **Leptogium laceroides** B.de Lesd. (x4)
F **Parmeliella thysanota** (Stirton) Zahlbr. (x15)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wet, brown when dry, mat, fissured, sometimes with laminar soredia. Cyanobiont **Nostoc**, packed in clusters, individual cells 6-10 µm diam.Lower surface without cortex, whitish at the apices and with brown tomentum, formed by short-celled hyphae, centrally; with white or brown rhizines up to 2 mm long.

Apothecia not seen.

Habitat: Found on **Nothofagus pumilio**, near the base of the trees, on shaded areas. Growing on trees covered with mosses or directly on bark. Cerro López at 1200 m above sea level.

Specimen examined: Argentina, Provincia de Río Negro, Dpto. Bariloche, Cerro López, E slope, col. Calvelo, 4-IV-1987. (BCRU 00033).

Distribution: New Zealand, Tasmania, Argentina.

This is the first record outside Australasia.

LEPTOGIUM LACEROIDES B. de Lesd. (Fig. 3E).
Bouly de Lesdain,M., Annals Cryptog. Exot. 6 (C): 112. 1933.

Thallus foliose, homoiomerous, lobes rounded up to 8 mm wide, extending over the substrate, except for the margins that may be ascendent; margins incised. Gelatinous when wet, papery when dry. Upper surface almost black when wet, blue-grey when dry, smooth, with patches covered with numerous cylindrical to lobulate isidia.Lower surface pale grey, tomentose. Apothecia laminate, 1.5 to 2.5 mm diam.,disc reddish-brown. Ascospores ellipsoid, muriform, 30-33 x 11-16µm.

Habitat: Found on **Nothofagus pumilio** in shaded humid habitats, frequently near streams, on mosses. Cerro Carbón at 1050 m above sea level;Cerro Catedral at 1370 m above sea level and Cerro López at 1320 m above sea level.

Specimen examined: Argentina. Parque Nacional Nahuel Huapi, Cerro Carbón, SW slope,col. Calvelo, 2-V-1987 (BCRU 00032).

Distribution: Cosmopolitan.

The first record for Argentina.

PARMELIELLA THYSANOTA (Stirton) Zahlbr. (Fig.3F).
Zahlbruckner,A.,Cat. Lich. Univ. 3: 225. 1925.-
Pannaria thysanota Stirton, Proc. Phil. Soc.
Glasg. 10: 293. 1877.

Thallus squamulose, heteromerous, squamules circular to elongated, 1 to 2 mm in diam., with margins incised, crenated, toothed, loosely attachet to the substrate. Upper surface yellow-grey when dry to brownish-grey when wet. Lower surface brown centrally to white at the margins, with scattered rhizines. Marginal prothallus prominent, blackish-blue.
Apothecia sessile to subpedicellate, 0.2 to 0.3 (-0.4) mm diam., disc red-brown, with a thick margin concolorous whith the thallus.
Ascospores ellipsoid, 16-17 x 6-7 µm.

Habitat: Found on specimens of **Nothofagus dombeyi** covered with mosses, in the more humid and shadiest habitats of the area. Puerto Blest at 800 m above sea level.

Specimen examined: Argentina. Parque Nacional Nahuel Huapi, Puerto Blest, between Puerto Blest and Lago Frías, col.Lorenzo, 14-XI-1986 (BCRU 00035).

Geographical distribution: New Zealand and Argentina.

First record outside New Zealand.

DISCUSSION

Six species of corticolous lichens are reported for the first time from Argentina.

Leptogium laceroides, which is cosmopolitan (Galloway, 1985), is now added to the known flora of Argentina. For **Calicium leucochlorum** var. **paraguayense**, this find constitutes the southernmost locality of its distribution, since it was known, up to now, from Gran Chaco, Paraguay (Santesson, 1943). **Parmeliella thysanota** and **Haematomma hilare** were known as endemic for New

Zealand **Nothofagus** forests (Galloway, 1985; Rogers and Bartlett, 1986), **Hypogymnia pulverata**, recorded previously for Australasia (Galloway, 1985), and **Leioderma amphibolum** known from New Zealand and Tasmania cool temperate rainforest (Galloway and Jørgensen, 1987), are now added to the known flora of **Nothofagus** forest in Argentina.

The last four species mentioned present a widely disjunct circumantarctic distribution: Australasia - Southern South America. They have been found in habitats with similar ecological characteristics, and three of them (**Haematomma hilare, Leioderma amphibolum** and **Parmeliella thysanota**) even on phorophytes of the same genus (**Nothofagus**). This distribution pattern can be explained by the late relationship between the areas as parts of Gondwanaland and/or by more recent long - distance dispersal of propagules by the West Wind Drift (Galloway, 1987) The observations made are further evidence of the resemblance of the cool temperate **Nothofagus** forest flora in circumantarctic territories.

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GIGASPORA RAMISPOROPHORA: A NEW SPECIES WITH NOVEL SPOROPHORES FROM BRAZIL

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ABSTRACT

Gigaspora ramisporophora develops sporophores (term suggested for the spore bearing structure in the Endogonaceae) with morphological variation from other described species in the genus. The sporophore may be simple, having a single sporogenous cell (term recommended to replace suspensor-like cell), or branched, forming multiple (2-3) sporogenous cells. A protrusion on a sporogenous cell may give rise to a branch with a spore. The spore is characterized by a hyaline to sub-hyaline wall over two pigmented walls. The middle wall is laminate. Germ tubes emerge from the germinal wall (term introduced to describe a wall distinctive in both texture and function) and directly penetrate the outer walls.

SUMÁRIO

Gigaspora ramisporophora desenvolve esporóforos (termo sugerido para estruturas que sustentam o esporo nas Endogoneceae) com características morfológicas que variam de outras espécies descritas no gênero O esporóforo pode ser simples, tendo uma única célula esporogênica (termo recomendado para substituir célula de sustentação), ou ramificado, formando células esporogênicas múltiplas (2-3). Uma protuberância na célula esporogênica pode desenvolver uma ramificação com um esporo. O esporo é caracterizado pela presença de uma parede hialina a sub-hialina sobre duas paredes pigmentadas. A parede mediana é laminada. Tubos de germinação emergem da parede germinal (termo introduzido para descrever uma parede distinta em textura e função) e penetram directamente nas paredes externas.

INTRODUCTION

Spores of an undescribed species of Gigaspora were recovered by wet sieving soil and root samples from plots of Pueraria phaseoloides. The golden yellow to yellowish-brown spores varied greatly in size and some were borne on branched sporophores. The novel features of the sporophore are described in this paper. The suggested terms "sporophore", used in the Endogonaceae by Tandy (1975) and Ferrer and Herrera (1980), and "sporogenous cell are discussed. The spore wall description follows the terminology of Walker (1983) with the exception of "germinal wall".

GIGASPORA RAMISPOROPHORA Spain, Sieverding et Schenck sp. nov. Figures 1-4

Spora formatur plerumque in apice cellulae sporogenae. Sporae lutae vel fulvae, globosae, (96-)200-450(-567) µm diam. vel subglobosae, (143-)150-400 X 200-450(501) µm diam. Totus paries sporae 9-31 µm crassus, constans ex stratis tribus: stratum exterior 1.4-4.0(-5.7) µm tenue; medianum lamellatum, 4-28 µm crassum; interior 1.3-2.6 µm tenue cum papillis, adhaesum ad stratum secundum vel separatum in regione quo spora germinat. Sporophori plerumque singulari vel bipartiti vel tripartiti ramosi. Sporophori cum cellula inflata terminant; cellula inflata quae cellula sporogena est, (32-)40-60(-72) µm lata et (50-)60-80(-83) µm longa; unae rare duae cellulae inflatae sub cellula sporogena. Sporophori novi non rare ex cellula sporogena progerminant. Cellulae auxiliares usque ad 20 in fasiculo humi vel in cortice radiciarum vel in stercore herbarum formantur. Cellulae auxiliares primo leves deinde cum projectionibus digitoidis, usque ad 10 µm longae. Spora directe per parietem germinans. Endomycorrhizam cum arbusculis in radicibus.

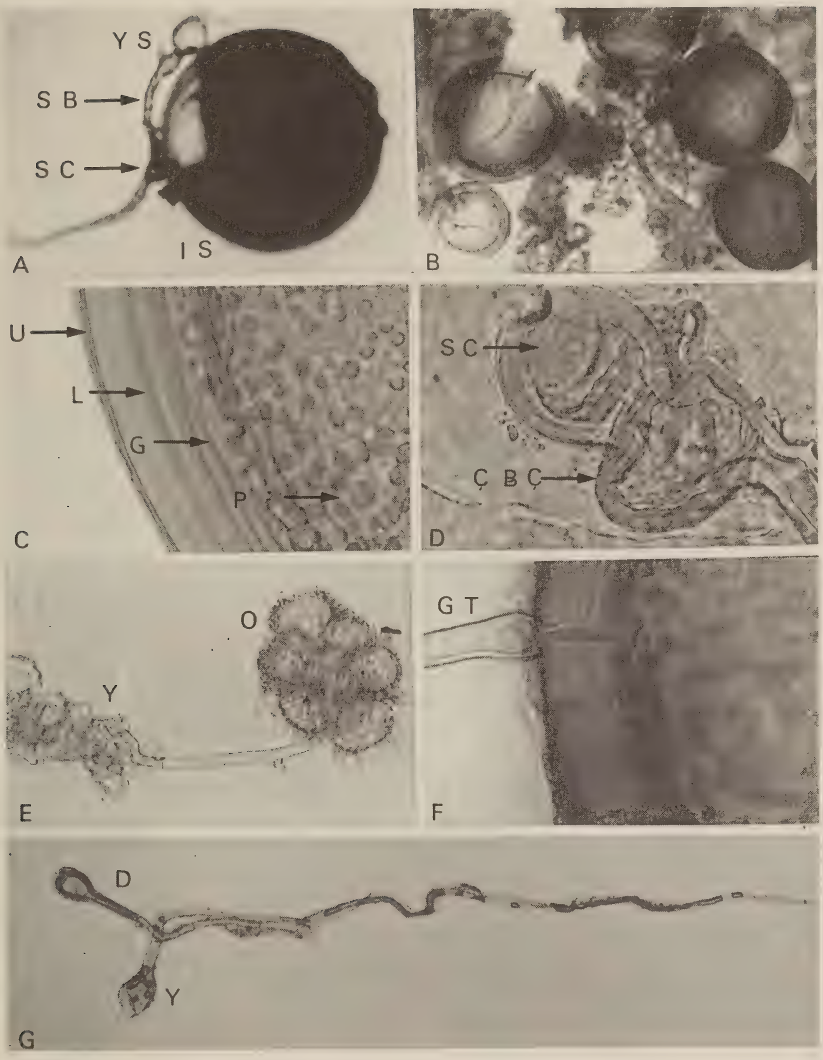

Figure 1. Gigaspora ramisporophora. A. Young spore (YS) on sporophore branch (SB) emanating from sporogenous cell (SC) attached to immature spore (IS) 160X. B. Colonized organic matter 63X C. Spore walls: unit (U); laminated (L); germinal (G) with papillae (P) 400X. D. Sporogenous cell (SC) with contiguous bulbous cell (CBC) 400X. E. Auxiliary cells: ornamented (O); young (Y) 400X. F. Germ tube (GT) 400X. G. Branched sporophore with two sporogenous cells: young (Y); detached from spore (D) 250X.

SPORE, usually formed at apex of bulbous sporogenous cell, smooth, golden yellow to yellowish-brown, globose, (96-)200-450(567) µm to sub-globose, (143-)150-400 X 200-450(-501) µm; total wall thickness 9-31 µm.

SPORE WALL STRUCTURE (Figs. 1-C, 4) of three walls in a single group. Spores measured in water or fixed in FAA and mounted in lactophenol. Wall 1, unit wall, hyaline to sub-hyaline, brittle, 1.4-4.0(-5.7) µm thick, continuous with outer wall of sporogenous cell and usually adherent to wall 2; wall 2 laminate, yellow to yellowish-brown, 4.0-28 µm thick, adherent to wall 3; outer part of wall 2 continuous with middle wall of sporogenous cell; wall 3, germinal wall, yellow to yellowish-brown, 1.3-2.6 µm thick excluding papillae, 1.4-8.3 µm diam. and up to 5.6 µm high, which develop prior to germination. Walls 2 and 3 are reactive to Melzer's reagent turning reddish-purple. Spore contents finely granular.

BULBOUS SPOROGENOUS CELL (Fig. 2), apical or sub-apical cell of sporophore, (32-)40-60(-72) X (50-)60-83 µm usually with three walls totalling 6-11(-14) µm thick: outer wall hyaline; laminate middle wall and innermost wall brown. Wall thickness variable, usually greater at spore initial site. Sporogenous cells may develop a branch (sporogenous cell with connecting hypha) which gives rise to another spore (Fig. 1-A). The sporogenous cell may have thick-walled, 3-4 µm, hyphal protrusions (pegs), 8-10 µm diam. A thin-walled hypha, 0.7-3 µm, with 6-8 µm diam., may extend from a thick-walled protrusion or develop directly from the sporogenous cell wall.

SPOROPHORE (Figs. 1-G, 3) light brown, simple or branched with 1-3 sporogenous cells, formed of specialized septate hypha, 9.3-13.9 µm diam., wall 1.4-2.8 µm thick (excluding bulbous cell measurements); distance between septae variable but septation more frequent near sporogenous cell. One or rarely two bulbous cells, some with hyphal protrusions, may be contiguous with apical sporogenous cell (Figs. 1-D, 2 I-L).

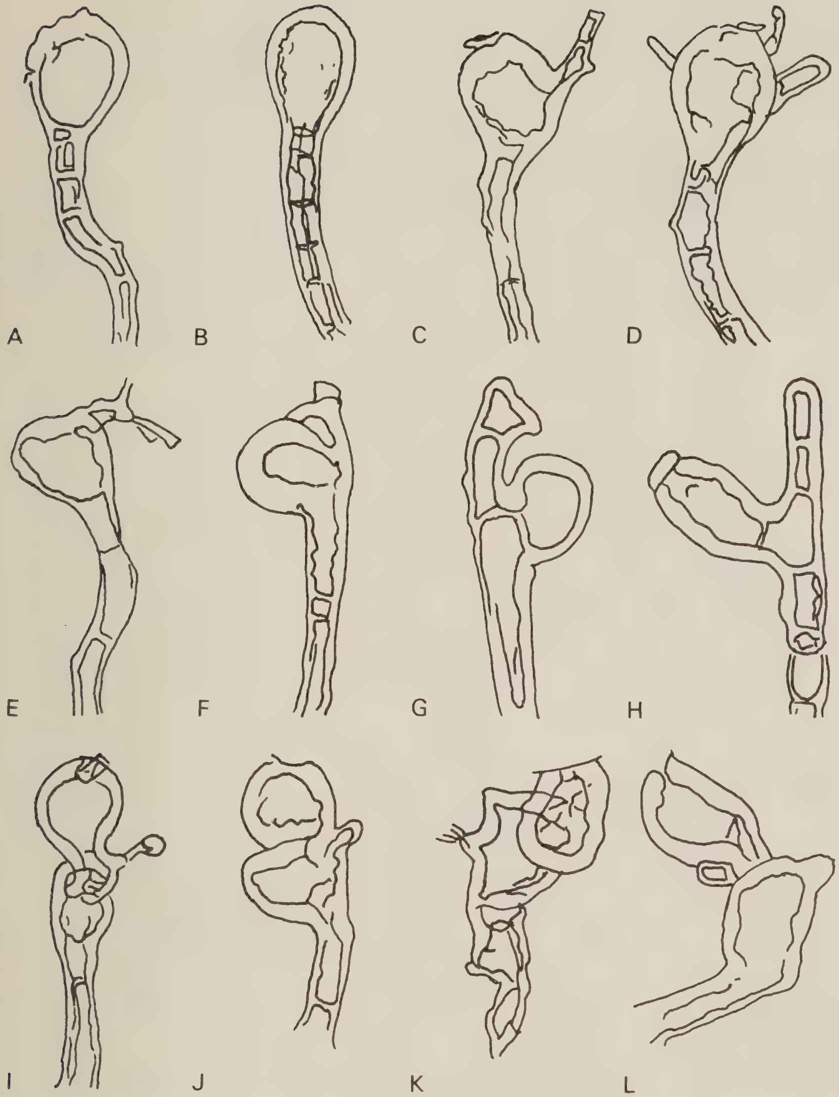

Figure 2. Sporogenous cells of Gigasporophora ramisporophora: A-F) apical sporogenous cells; C-F) sporogenous cells with thick hyphal protrusions (pegs) or slender hyphae; G-H) subapical sporogenous cells; I-L) sporogenous cells with contiguous bulbous cells. Camera lucida drawings.

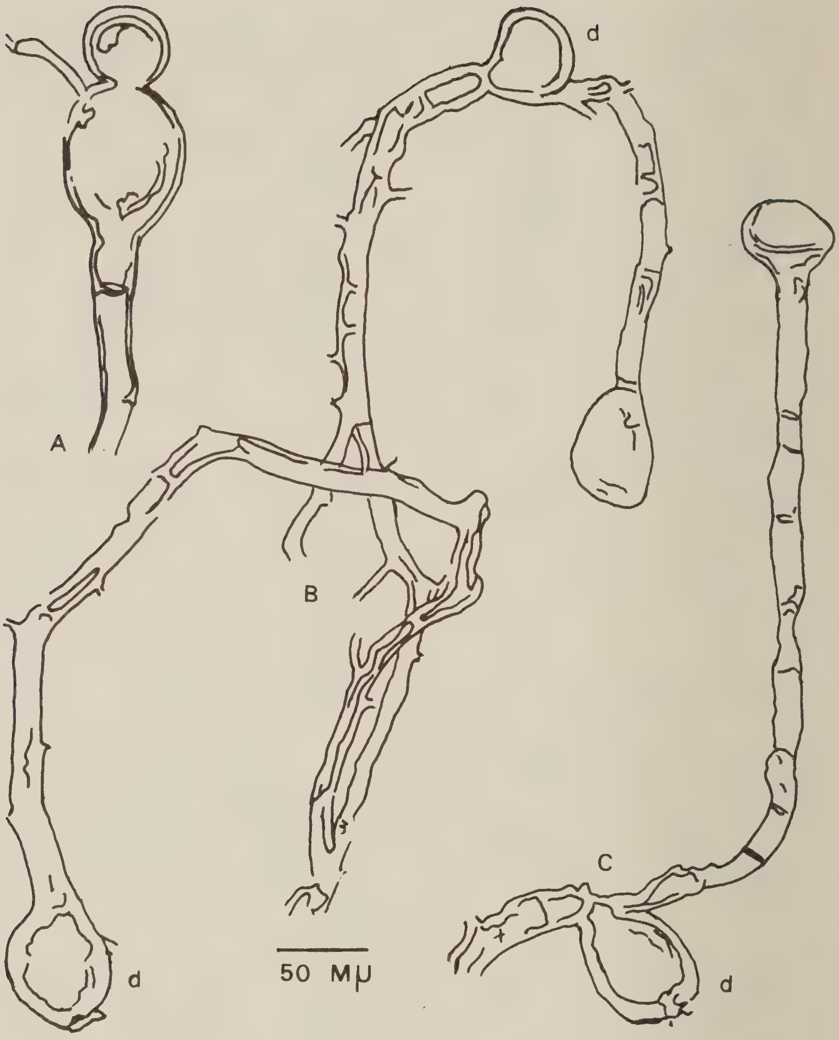

Figure 3. Sporophores of Gigaspora ramisporophora: A) young spore forming from sporogenous cell on simple sporophore; B) branched sporophore with three sporogenous cells, two with spores detached (d); C) branched sporophore with two sporogenous cells, one with spore detached (d). Camera lucida drawings.

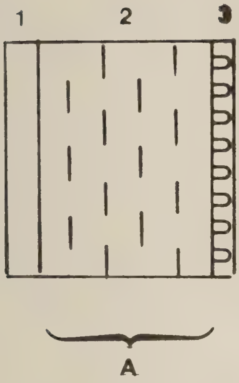

Figure 4. Murograph: Gigaspora ramisporophora. One group, A; three walls: unit, laminated & germinal.

AUXILIARY CELLS (Fig. 1-E) tan, round to clavate, 24-41 µm diam.; smooth initially becoming ornamented with digitate projections (rarely bifurcate) up to 10 µm high; borne in clusters of less than 20 on coiled hyphae, 6-8 µm diam., with thin walls, 0.5-1.3 µm; coils develop on short hyphal stalks or along the coenocytic hyphae. Auxiliary cells found in the mineral soil, decomposing organic matter and in the cortex of roots.

DIRECT GERMINATION (Fig.1-F): one to several germ tubes (1-8; $\overline{x}$ 4) emerge from the germinal wall where the papillae are largest. The germ tube within the spore wall is 5.6-9.7 µm diam. and at egress 14-17(-22) µm diam.

ENDOMYCORRHIZAE formed with arbuscules.

TYPE obtained from a pot culture with Sorghum halipense, previously seeded with P. phaseoloides Benth, culture CP 75, at the Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahía, Brasil. Holotype FLAS; Isotypes OSC, GOET and IBt.

ETYMOLOGY: Latin, rami (branch), referring to the sporophore configuration.

DISTRIBUTION, HABITAT AND MYCORRHIZAL ASSOCIATIONS: Gigaspora ramisporophora is known from a single site in southern Bahia. Spores associated with P. phaseoloides were collected from a CEPEC forage seed production field 2 km east of Itapebi. Decomposing plant residues were frequently colonized and abundant spore production occurred. Chemical analysis of surface soil: pH 6.3; P 4 mg/kg soil; exch. Al 0.0; Ca 5.7, Mg 1.3, K 0.26 meq/100g soil. Pot cultures were established in CEPEC, Itabuna, Bahia; the fungus formed a symbiosis with P. phaseoloides and S. halipense producing arbuscules and auxiliary cells in roots and auxiliary cells and spores in decomposing organic matter and mineral soil.

DISCUSSION

Gigaspora ramisporophora spores closely resemble yellow spores of G. decipiens, however, spores of the latter species can also be colorless, pale greenish-yellow or light brown at germination. Total wall thickness parameters overlap but the wall configurations are distinct. G. ramisporophora spores have an outer unit wall, a laminated middle wall and an inner germinal wall; Hall & Abbott (1984) describe a spore wall which changes as the spores age; older spores of G. decipiens have two laminated walls (the outer wall being replaced by 2-3 laminations) over the germinal wall. The refringency of the germinal wall differs from the adhering laminated wall in both species. Large papillae are more numerous and more widely distributed on the germinal wall of G. ramisporophora; germ tubes develop in the area where the papillae are largest, near the sporogenous cell or elsewhere. Germ tubes of G. decipiens emerge near the sporogenous cell usually from clusters of large papillae. Although small papillae may be generalized in both spores they are more often widespread on the germinal wall of G. ramisporophora and confined to the area around the sporogenous cell of G. decipiens. The germinal wall of both species adheres tightly to the middle laminated wall, however, the papillose area can wrinkle when spores are mounted in lactophenol. The sporophore of G. ramisporophora may be simple with a single sporogenous cell or branched having

2-3 sporogenous cells. Branched sporophores have not been reported for other species in the genus.

Dr. R.E. Koske (pers. comm.) interprets wall 3 as the innermost layer of laminated wall 2. We think the germinal wall is a separate wall. This wall was first described by Sward (1981a, b, c) studying the spore wall structure of G. margarita Becker & Hall. The germinal wall (Fig. 4) is represented by a depiction of papillae which form on the inside prior to germination.

One or rarely two bulbous cells contiguous with an apical sporogenous cell are sometimes present on sporophores of G. ramisporophora (Figs.1-D, 2 I-L). Similar structures have been observed on sporophores of Scutellospora pellucida (Nicol. & Schenck) Walker & Sanders, S. heterogama (Nicol. & Gerd.) Walker & Sanders and an undescribed Scutellospora species. Nicolson and Gerdemann (1968) may have reported the same anomaly when they noted that Endogone heterogama (S. heterogama) had "usually one, occasionally two, bulbous suspensors 21-26 µm diam. with a slender hypha extending from the suspensor to the base of the spore...".

Our findings suggest that thick hyphal protrusions, and perhaps the slender hyphae, extending from the sporogenous cells of Gigaspora and Scutellospora species, once thought to be antheridium-like (Gerdemann, 1955) or small suspensors (Nicolson and Gerdemann, 1968) may be vestigal sporophore branches. A branch (sporogenous cell and connecting hypha) emanating from an apical, bulbous sporogenous cell has been a frequent finding in G. ramisporophora; three observations have been made by the senior author of immature spores forming on these branches (Fig. 1-A).

The colonization of decomposing plant residues by G. ramisporophora (Fig. 1-B) results in abundant spore production. This phenomenon has also been observed with some other Gigaspora and Scutellospora species. Ferrer and Herrera (1980) reported finding S. heterogama spores inside seed coats and Arvantes and Taber (1985) reported abundant Gigaspora spores in weed seeds.

TERMINOLOGY

Becker and Hall (1976) use the term "subtending hypha" for the connecting hypha and the structure variously referred to as a bulbous swelling (Gerdemann, 1955), a suspensor (Nicolson and Gerdemann, 1968), an attachment of a bulbous nature interpreted as a suspensor (Old et al., 1973), a suspensor-like cell (Gerdemann and Trappe, 1974) and bulbous and hyphal suspensor-like cells (Brown and King, 1982). Prior to spore formation "subtending hypha" would be a misnomer; another term is needed. Ferrer and Herrera (1980), describing spores in the genus Gigaspora, apparently limit the term "sporophore" to the "sporogenous cell", however, it can be interpreted broadly (Snell and Dick, 1971; Hawksworth et al., 1983) and is the term suggested for the spore bearing hypha(e) in the Endogonaceae. Tandy (1975) used the term for a Glomus species. The term "sporogenous cell" (spore-producing cell(s) of the sporophore) recognizes the specialized function of the cell.

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A NUMERICAL TAXONOMIC STUDY OF SOME PHIALIDIC GENERA OF HYPHOMYCETES: CLUSTER ANALYSIS

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SUMMARY

Cluster analysis by the unweighted pair group method using arithmetic averages (UPGMA) was performed on morphological data from 28 characters of 114 species of some dematiaceous, phialidic genera of Hyphomycetes.

As a result of this analysis some species were found very closely related such as the species of the genera Bahusutrabeeja, Gonytrichum and Menisporopsis, and the majority of the species of Dictyochaeta and Menispora, but others need a revision namely: Codinaea apicalis, C. state of Chaetosphaeria dingleyae, C. elegantissima, C. filamentosa, C. glauco-nigra, C. intermedia, C. maharashtrensis and Dictyochaeta menisporoides, which probably need a different treatment. The same occurs with Menispora britannica and M. uncinata. The genera Chaetopsina, Chaetopsis and Kionochaeta probably must be reconsidered.

INTRODUCTION

The anamorph genera have always been a great problem to workers on taxonomy. This is due to the characters used to define them, that are often inadequate, poorly defined or purely monothetic. As pointed out by Kendrick and DiCosmo (1979), the final solution to this problem will be arrived at only when we can find the relationships with the teleomorphic-form.

Although the problems involved are known to every mycologist, only a few attempts have been made to find general rules for linking the two systems. On the other hand the amount of anamorph genera described in the literature is increasing day by day. This fact has led us to create genera whose concepts are superposed and for this reason some species share characters with more than one genus.

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Kendrick (1980) considered the generic concepts in Hyphomycetes and proposed the amalgamation of several genera, because their delimitation was confusing and inadequate. As a first approach DiCosmo et al. (1983) hypothesized that there was not enough justification for maintaining Cylindrotrichum Bonorden and Chaetopsis Greville as separate anamorph genera. For this reason they disregarded them. Nevertheless, Cabello and Arambarri (1988) revised the genus Cylindrotrichum and found out it was valid and different from Chaetopsis.

In this paper we are including 114 form-genera having in common macronematous, dematiaceous, unbranched or occasionaly branched conidiophores, with or without setae, that may be independent structures or become the sterile or fertile prolongations of conidiophores. In the latter case, the conidiogenous cells are arranged at the mid level of the conidiophore and may be arise sessile or otherwise on branches of varing length. In all the species considered here the ontogenic origin of the conidia is phialidic with or without percurrent and/or sympodial proliferation. The conidia are grouped in slime heads.

Gams and Holubová-Jechová (1976) and DiCosmo et al. (1983) diagramed and illustrated the habit of some genera considered in the present paper.

One of the purpose of this paper is to analyse phenetic similarities among the species of the genera considered here, and to establish if all the species of one genus are clustering together or if they appear mixed with the species of other genera. The latter situation will be analysed in another paper with the purpose of finding out the delimitation of the genera that appear confuse and inadequate according with the idea of Kendrick.

SPECIES ANALYSED

Bahusutrabeeja angularis Vasant Rao & de Hoog;
Bahusutrabeeja dwaya Subram. & Bhat;

Chaetopsina auburnensis Morgan Jones;
Chaetopsina catenulata Samuels;
Chaetopsina fulva Rambelli;
Chaetopsina penicilliata Samuels;
Chaetopsina polyblastia Samuels;
Chaetopsina splendida Sutton & Hodges;
Chaetopsina unilateralis Kirk;

Chaetopsis grisea (Ehrenberg) Saccardo;
Chaetopsis romantica (Rambelli & Lunghini) DiCosmo, Berch & Kendrick;

Chloridium atanagildae Holubová-Jechová apud Holubová-Jechová & Mercado;
Chloridium botryoideum (Corda) Hughes;
Chloridium caudigerum (Höhnel) Hughes;
Chloridium chlamydosporis (van Beyma) Hughes;
Chloridium clavaeforme (Preuss) Gams & Holubová-Jechová;

Chloridium codinaeoides Pirozynski;
Chloridium cubense Holubová-Jechová;
Chloridium cylindrosporum Gams & Holubová-Jechová;
Chloridium lignicola (Mangenot) Gams & Holubová-Jechová;
Chloridium matsushimae Gams & Holubová-Jechova;
Chloridium pachytrachelum Gams & Holubová-Jechová;
Chloridium paucisporum Wang & Wilcox;
Chloridium phaeosporum Gams & Holubová-Jechová;
Chloridium preussii Gams & Holubová-Jechová;
Chloridium reniforme Matsushima;
Chloridium smithiae Sinclair & Eicker;
Chloridium transvaalense Morgan Jones;
Chloridium virescens (Pers. ex Pers.) Gams & Holubová-Jechova;
Cylindrotrichum clavatum Gams apud Gams & Holubová-Jechová;
Cylindrotrichum curvatum Morgan Jones;
Cylindrotrichum ellisii Morgan Jones;
Cylindrotrichum excentricum (Bhat & Sutton) Cabello & Arambarri;
Cylindrotrichum fasciculatum Mercado Sierra;
Cylindrotrichum hennebertii Gams & Holubová-Jechová;
Cylindrotrichum oblongisporum Morgan Jones;
Cylindrotrichum oligospermum Bonorden;
Cylindrotrichum probosciophorum (DiCosmo, Berch & Kendrick) Arambarri & Cabello;
Cylindrotrichum proliferum Matsushima;
Cylindrotrichum triseptatum Matsushima;
Cylindrotrichum zygnöellae (Höhnel) Gams & Holubová-Jechová;

Dictyochaeta abnormis Holubová-Jechová;
Dictyochaeta apiculata (Matsushima) Arambarri & Cabello comb. nov.
    Basionym: *Codinaea apiculata* Matsushima;
Dictyochaeta aristata (Maire) Arambarri & Cabello comb. nov.
    Basionym: *Codinaea aristata* Maire;
Dictyochaeta assamica (Agnihothrudu) Arambarri, Cabello & Mengascini;
Dictyochaeta botulispora (Hughes & Kendrick) Cabello & Arambarri comb. nov.
    Basionym: *Codinaea botulispora* Hughes & Kendrick;
Dictyochaeta brevisetula (Hughes & Kendrick) Cabello & Arambarri comb. nov.
    Basionym: *Codinaea brevisetula* Hughes & Kendrick;
Dictyochaeta state of *Chaetosphaeria callimorpha* (Mont.) Sacc.;
Dictyochaeta clavulata (Holubová-Jechová) Holubová-Jechová;
Dictyochaeta coffeae (Maggi & Persiani) Cabello & Arambarri comb. nov.
    Basionym:: *Codinaea coffeae* Maggi & Persiani;
Dictyochaeta cylindrospora (Morgan Jones & Ingram) Arambarri & Cabello comb. nov.
    Basionym: *Codinaea cylindrospora* Morgan Jones & Ingram;
Dictyochaeta dimorpha (Toyazaki & Udagawa) Arambarri &

Cabello comb. nov.
Basionym: *Codinaea* *dimorpha* Toyazaki & Udagawa;
Dictyochaeta *eucalypti* (Sutton & Hodges) Cabello & Arambarri comb. nov.
Basionym: *Codinaea* *eucalypti* Sutton & Hodges;
Dictyochaeta *fertilis* (Hughes & Kendrick) Holubová-Jechová;
Dictyochaeta *fuegiana* Spegazzini;
Dictyochaeta *gamundii* Arambarri & Cabello apud Arambarri, Cabello & Mengascini;
Dictyochaeta *heteroderae* (Morgan Jones) Cabello & Arambarri comb.nov.
Basionym: *Codinaea* *heteroderae* Morgan Jones;
Dictyochaeta *hughesii* (Ellis) Arambarri & Cabello comb. nov.
Basionym: *Codinaea* *hughesii* Ellis;
Dictyochaeta *illinoensis* (Hewings & Crane) Arambarri & Cabello comb. nov.
Basionym: *Codinaea* *illinoensis* Hewings & Crane;
Dictyochaeta *longispora* (Hughes & Kendrick) Cabello & Arambarri comb. nov.
Basionym: *Codinaea* *longispora* Hughes & Kendrick;
Dictyochaeta *lunata* (Matsushima) Arambarri & Cabello comb. nov.
Basionym: *Codinaea* *lunata* Matsushima;
Dictyochaeta *lunulospora* (Hewings & Crane) Cabello & Arambarri comb. nov.
Basionym: *Codinaea* *lunulospora* Hewings & Crane;
Dictyochaeta *matsushimae* (Hewings & Crane) Arambarri & Cabello comb. nov.
Basionym: *Codinaea* *matsushimae* Hewings & Crane;
Dictyochaeta *menisporoides* Holubová-Jechová;
Dictyochaeta *novae-guineensis* (Matsushima) Romero;
Dictyochaeta *obesispora* (Hughes & Kendrick) Cabello & Arambarri comb. nov.
Basionym: *Codinaea* *obesispora* Hughes & Kendrick;
Dictyochaeta *parva* (Hughes & Kendrick) Arambarri & Cabello comb. nov.
Basionym: *Codinaea* *parva* Hughes & Kendrick;
Dictyochaeta state of *Chaetosphaeria* *pulchriseta* Hughes, Kendrick & Shoemaker;
Dictyochaeta *querna* Kirk;
Dictyochaeta *septata* (Sutton & Hodges) Arambarri & Cabello comb. nov.
Basionym: *Codinaea* *septata* Sutton & Hodges;
Dictyochaeta *setosa* (Hughes & Kendrick) Cabello & Arambarri comb. nov.
Basionym: *Codinaea* *setosa* Hughes & Kendrick;
Dictyochaeta *simplex* (Hughes & Kendrick) Holubová-Jechová;
Dictyochaeta state of *Chaetosphaeria* *talbotii* Hughes, Kendrick & Shoemaker;
Dictyochaeta *tilikfrei* Bhat & Sutton;
Dictyochaeta *triseptata* (Matsushima) Castañeda;
Dictyochaeta *unisetula* (Morgan Jones & Ingram) Cabello & Arambarri comb. nov.
Basionym: *Codinaea* *unisetula* Morgan Jones & Ingram;
Dictyochaeta *vulgaris* (Hughes & Kendrick) Cabello & Arambarri comb. nov.

Basionym: *Codinaea* *vulgaris* Hughes & Kendrick.

Gonytrichum *caesium* G.G.& Nees ex Leman;
Gonytrichum *chlamydosporium* Barron & Bhat;
Gonytrichum *macrocladum* (Sacc.) Hughes;
Gonytrichum *mirabile* Holubová-Jechová apud Gams & Holubová-Jechová;
Gonytrichum *ypsilosporum* Holubová-Jechová;

Kionochaeta *aristata* Kirk apud Kirk & Sutton;
Kionochaeta *ivoriensis* (Rambelli & Lunghini) Kirk & Sutton;
Kionochaeta *keniensis* (Kirk) Kirk & Sutton;
Kionochaeta *malaysiana* Kirk apud Kirk & Sutton;
Kionochaeta *nanophora* Kuthubutheen & Nawawi;
Kionochaeta *pughii* Kuthubutheen & Nawawi;
Kionochaeta *ramifera* (Matsushima) Kirk & Sutton;
Kionochaeta *spissa* Kirk & Sutton;
Kionochaeta *virtuosa* (Rambelli & Lunghini) Kirk & Sutton;

Menispora *britannica* (Ellis) Kirk;
Menispora *ciliata* Corda;
Menispora *glauca* Pers.
Menispora *manitobaensis* Sutton;
Menispora state of *Chaetosphaeria* *pulviscula* (Curr.) Booth;
Menispora *tortuosa* Corda;
Menispora *uncinata* Hughes & Kendrick;

Menisporopsis *ludoviciana* (Crane & Schoknecht) Kirk & Sutton;
Menisporopsis *novae-zelandiae* Hughes & Kendrick;
Menisporopsis *pleiosetosa* Rao & de Hoog;
Menisporopsis *profusa* Pirozynski & Hodges;
Menisporopsis *theobromae* Hughes;

Zakatoshia *hirschiopori* Sutton;

Zanclospora *austroamericana* Sutton & Hodges;
Zanclospora *brevispora* Hughes & Kendrick;
Zanclospora *novae-zelandiae* Hughes & Kendrick.

***Codinaea* *apicalis* Berk & Curt.
***Codinaea* state of *Chaetosphaeria* *dingleyae*;
***Codinaea* *elegantissima* Lunghini apud Lunghini, Rambelli & Onofri;
***Codinaea* *filamentosa* Onofri apud Lunghini, Rambelli & Onofri;
***Codinaea* *glauco-nigra* Cooke & Ellis
***Codinaea* *intermedia* Rambelli apud Lunghini, Rambelli & Onofri;
***Codinaea* *maharashtrensis* Pirozynski & Patil.

**These species are not recombinated because they will be reubicated in a latter paper.

OBSERVATIONS: We have not considered the following species: *Chaetopsis* *cubensis* Castañeda; *Cylindrotrichum* *gorii* Lunghini; *Codinaea pakhalensis* S.M. & S.S. Reddy; *Codinaea australensis* Sutton; *Codinaea tortuosa* Sutton; *Menisporopsis pirozynskii* Varghese & Rao; *Gonytrichum indicum* Sharma & Munjal and *Zanclospora mystica* Zucconi & Rambelli; since the original descriptions or the type material were not available. On the other hand *Cylindrotrichum helisciforme* Marvanová, as DiCosmo et al. (1983) have suggested, could be a species of *Heliscus* Sacc., because its characters do not match the genus *Cylindrotrichum*.

MATERIALS AND METHODS

The two species of the genus *Bahusutrabeeja* Subram. & Bhat; 7 species of *Chaetopsina* Rambelli; 2 species of *Chaetopsis* Greville; 18 species of *Chloridium* Link:Fr.; 7 species of *Codinaea* Maire; 12 species of *Cylindrotrichum* Bonorden; 36 species of *Dictyochaeta* Spegazzini; 5 species of *Gonytrichum* C. J. & F. Nees ex Leman; 9 species of *Kionochaeta* Kirk & Sutton; 7 species of *Menispora* Persoon; 5 species of *Menisporopsis* Hughes; one species of *Zakatoshia* Sutton and 3 species of *Zanclospora* Hughes & Kendrick; constitute the 114 Operational Taxonomical Units (OTU) (Sneath & Sokal, 1973).

The characters used have been obtained after studying original descriptions of the species.

The data consisted of 28 characters scored for each of the 114 OTU. All the characters were qualitative. Part of the characters were scored as double state data: presence (1), absence (0). The double state data, excluding state, were scored with (1) or (2) indistinctly. In some characters such as: conidiogenous cells sessile on the conidiophore and conidiogenous cells growing on branches, we found that some species included both states; it is clear that the best scoring to cover the possibilities could be as follows: conidiogenous cells sessile on the conidiophore (1), conidiogenous cells on branches (2) and, conidiogenous cells sessile or/on branches (1.5). A similar situation occurs with characters 14, 16 and 17.

The characters were scored for each OTU as follows:

1) Conidiophores: mononematous (Fig. 1 B & C) (1); synnematous (Fig. 1 A) (2).

2) Conidiophores synnematous with central setae :present (Fig. 1 A) (1) or absent (0).

3) Conidiophore branched: present (1) or absent (0).

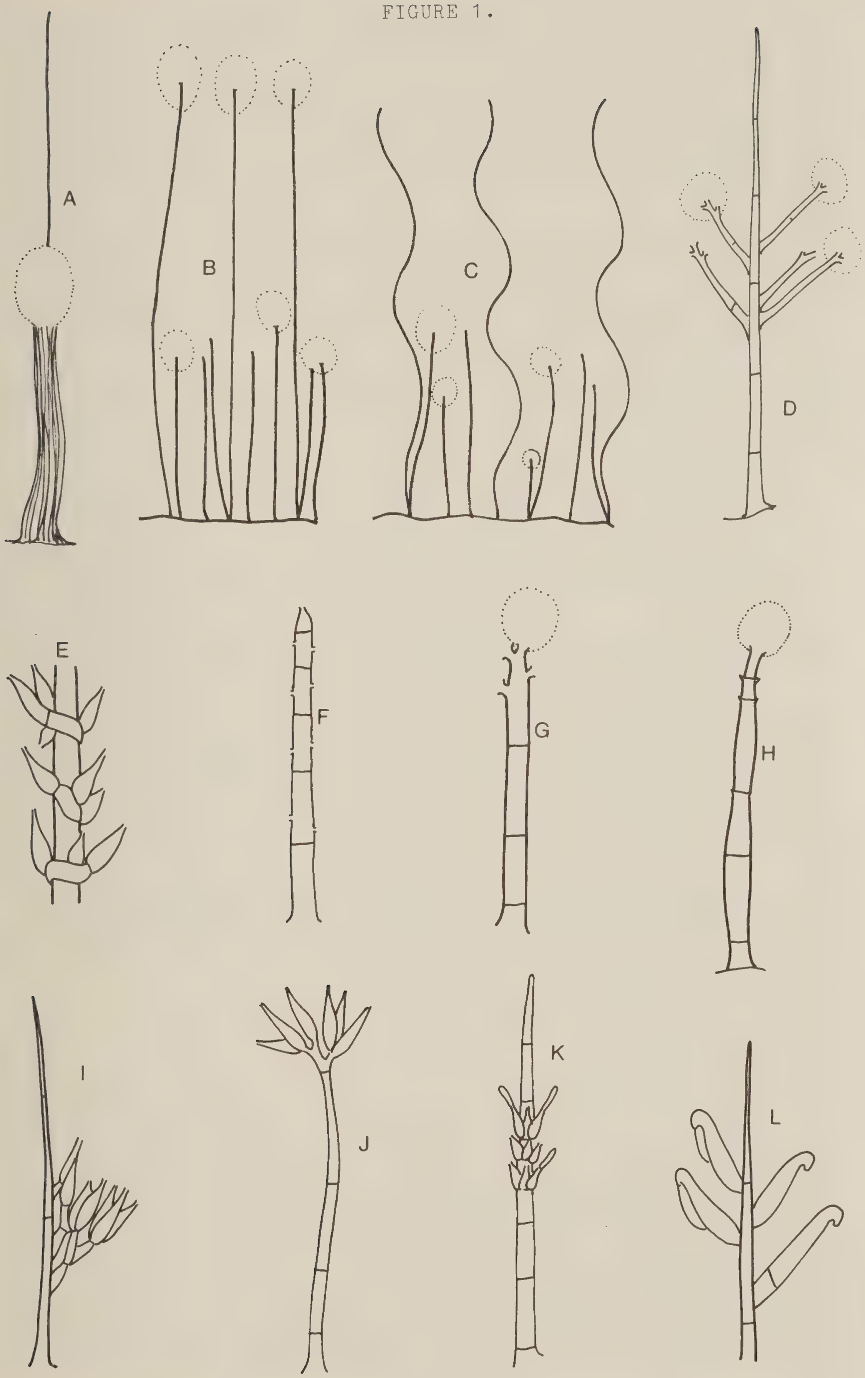
4) Conidiogenous cells growing on the conidiophore (not as a cells of the conidiophore): present (Fig. 1 D-E-I-J-K & L) (1) or absent (0).

5) Conidiogenous cells terminal (Fig. 1 G-H) (1), terminal and intercalary (Fig. 1 F) (2), terminal on branches (3).

6)Conidiophore extending far from the conidiogenous cells: present (Fig. 1 D-I-K & L) (1), or absent (Fig. 1 H & J)(0).

7) Extension of the conidiophore fertile: present (1) or absent (0).

FIGURE 1.


A
B
C
D
E
F
G
H
I
J
K
L

8) Extension of the conidiophore: straight (1) or flexuose (2).
9) Conidiophore without setae (0), with several setae (Fig. 1 B & C) (1), with only one seta (Fig. 1 A) (2).
10) Fertile setae: present (Fig. 1 B) (1) or absent (Fig 1 C) (0).
11) Setae: Straight (Fig. 1 B) (1) ,flexuose (Fig. 1 C) (2).
12) Conidiogenous cells on the conidiophore (as cells of the conidiophiore) only at the apex: present (Fig. 1 G & H) (1), or absent (0).
13) Conidiogenous cells sessile on the conidiophore (Fig. 1 K) (1), on branches (Fig. 1 D-E-I & J)(2), sessile or/on branches (Fig. 1 L) (1.5).
14) Conidiogenous cells on branches (not collar hyphae): apical dispossed (Fig. 1 J) (1), in the mid part (Fig. 1 D & I) (2), apical and in the mid part (1.5).
15) Conidiophore bearing short curved lateral branches (collar hyphae): present (Fig. 1 E) (1) or absent (0).
16) Conidiogenous cells unilaterally arranged (Fig. 1 I)(1), anphigenous (verticillate) (Fig. 1 D-E & K) (2) and unilaterally and anphigenous (1.5)
17) Conidiogenous cells without proliferation (0), with sympodial proliferation (Fig. 1 G) (1), percurrent proliferation (Fig. 1 H) (2) and sympodial and percurrent proliferation (1.5).
18) Proliferations sympodial and/or percurrent scanty (1) or many (2).
19) Conidiogenous cells straight (1) or strongly curved (Fig. 1 L) (2).
20) Conidiogenous cells with conspicuous collarette: present (1) or absent (0).
21) Conidiogenous loci terminal (Fig. 1 H) (1), terminal and intercalary (Fig. 1 G) (2).
22) Conidiogenous cells lageniform: present (1) or absent (0).
23) Conidia 0-septate (1), septate (2).
24) Conidia with setulae: present (1) or absent (0).
25) Setulae as a prolongation of the wall of the conidia (1), mucous setulae (2).
26) Conidia straight: present (1) or absent (0).
27) Conidia symmetric: present (1) or absent (0).
28) Ratio L/W 1:1: present (1) or absent (0).

Data processing: a) A Basic Data Matrix (B.D.M.) (Table 1) of 28 characters by 114 OTU was developed. The value no comparable (NC) in characters 2, 7, 8, 10, 11, 13, 14, 15, 16, 18, 25 are a product of the kind of codification.

The computer work was done on a IBM 4361 using the NT-SYS programs developed by Rohlf et al. (1971). It was carried out at the Centro de Estudios Superiores para el Procesamiento de la Información (CESPI) of the University of La Plata.

b) Achievement of Similarity Matrix using the Average Euclidean Distance (Taxonomic Distance).

c) Cluster analysis: this analysis uses techniques that

TABLE 1. BASIC DATA MATRIX

Characters Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Bahusutrabeeja angularis	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1.5	1	1	1	2	0	1	1	2	NC	1	1
Bahusutrabeeja dwaya	1	NC	1	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1.5	1	1	1	2	0	1	1	2	NC	1	1
Chaetopsina auburnensis	1	NC	0	1	3	1	0	1	0	NC	NC	0	2	2	0	2	0	NC	1	0	1	1	1	0	NC	0	1	0
Chaetopsina catenulata	1	NC	1	1	3	0	NC	NC	0	NC	NC	0	2	1	0	2	0	NC	1	1	1	0	2	0	NC	1	1	0
Chaetopsina fulva	1	NC	0	1	3	1	0	1	0	NC	NC	0	2	2	0	2	0	NC	1	1	1	1	1	0	NC	1	1	0
Chaetopsina penicilliata	1	NC	0	1	3	0	NC	NC	0	NC	NC	0	2	1	0	2	0	NC	1	1	1	1	1	0	NC	1	0	0
Chaetopsina polyblastia	1	NC	1	1	3	0	NC	NC	0	NC	NC	0	2	1	0	1.5	1	1	1	1	2	1	1	0	NC	1	1	0
Chaetopsina splendida	1	NC	1	1	3	1	0	1	0	NC	NC	0	2	2	0	2	0	NC	1	1	1	1	1	0	NC	1	1	0
Chaetopsina unilateralis	1	NC	0	1	3	1	0	1	0	NC	NC	0	1	NC	0	1	0	NC	1	1	1	1	1	0	NC	0	0	0
Chaetopsis grisea	1	NC	0	1	3	1	0	1	0	NC	NC	0	2	2	0	1.5	1	1	1	1	2	0	2	0	NC	1	1	0
Chaetopsis romantica	1	NC	0	1	3	1	1	1	0	NC	NC	0	2	2	0	1.5	0	NC	1	1	1	1	1	0	NC	1	1	0
Chloridium atanagildae	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1	1	1	1	2	0	1	0	NC	0	0	0
Chloridium botryoideum	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1	2	1	1	1	0	1	0	NC	1	1	0
Chloridium caudigerum	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	0	NC	1	1	1	0	1	0	NC	1	1	0
Chloridium chlamydosporis	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	0	NC	1	1	1	0	1	0	NC	1	1	0
Chloridium clavaeforme	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	2	1	1	1	1	0	1	0	NC	1	1	1
Chloridium codinaeoides	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	2	1	1	0	1	0	1	0	NC	1	0	0
Chloridium cubense	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1.5	1	1	1	1	0	1	0	NC	1	1	1
Chloridium cylindrosporum	1	NC	0	0	1	0	NC	NC	1	1	1	1	NC	NC	NC	NC	1.5	1	1	1	2	0	1	0	NC	1	1	0
Chloridium lignicola	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	2	1	1	1	1	0	1	0	NC	1	1	0
Chloridium matsushimae	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	2	1	1	1	1	0	1	1	2	1	1	0
Chloridium pachytrachelum	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1	1	1	1	2	0	1	0	NC	1	1	1
Chloridium paucisporum	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1	1	1	1	1	0	1	0	NC	0	0	0
Chloridium phaeosporum	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1.5	1	1	0	1	0	1	0	NC	1	1	0
Chloridium preussii	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	2	1	1	1	1	0	1	0	NC	1	1	1
Chloridium reniforme	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	0	NC	1	0	1	0	1	0	NC	1	1	1
Chloridium smithiae	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1.5	2	1	1	2	0	1	0	NC	1	1	1
Chloridium transvaalense	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	0	NC	1	1	1	1	1	0	NC	1	1	0
Chloridium virescens	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	2	1	1	0	1	0	1	0	NC	1	1	1
Codinaea apicalis	1	NC	1	1	3	1	1	2	0	NC	NC	0	1.5	2	0	1.5	0	NC	1	1	1	0	2	0	NC	0	0	0
Codinaea st. C. dingleyae	1	NC	1	1	3	1	0	1	1	0	1	0	1.5	2	0	2	1	1	1	1	2	0	2	1	1	0	1	0
Codinaea elegantissima	1	NC	1	1	3	1	1	1	0	NC	NC	0	1.5	2	0	1	0	NC	1	1	1	1	1	1	1	0	1	0

TABLE 1. Cont....

Characters																											
Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Codinaea filamentosa	1	NC	1	1	3	1	0	2	0	NC	NC	0	1.5	2	0	2	0	NC	1	1	1	0	1	1	1	0	1	0
Codinaea glauco-nigra	1	NC	1	1	3	1	1	1	0	NC	NC	0	1.5	2	0	1.5	0	NC	1	1	1	0	2	0	NC	0	0	0
Codinaea intermedia	1	NC	1	1	3	1	1	1	0	NC	NC	0	1.5	2	0	2	0	NC	1	1	1	0	1	1	1	0	1	0
Codinaea maharashtrensis	1	NC	1	1	3	1	1	1	0	NC	NC	0	1.5	2	0	2	1	1	1	0	2	0	1	0	NC	0	0	0
Cylindrotrichum clavatum	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	2	1	1	0	1	0	2	0	NC	1	1	0
Cylindrotrichum curvatum	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1	1	1	1	2	0	2	0	NC	0	1	0
Cylindrotrichum ellisii	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	2	1	1	1	1	0	2	0	NC	1	1	0
Cylindrotrichum excentricum	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	2	1	1	0	1	1	2	0	NC	0	0	0
Cylindrotrichum fasciculatum	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	0	NC	1	0	1	0	2	0	NC	1	1	0
Cylindrotrichum hennebertii	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1	1	1	0	2	0	2	0	NC	1	1	0
Cylindrotrichum oblongisporum	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	2	1	1	1	0	0	2	0	NC	1	1	0
Cylindrotrichum oligospermum	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1.5	1	1	0	2	0	2	0	NC	1	1	0
Cylindrotrichum probosçiophorum	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1.5	1	1	0	2	0	2	0	NC	1	1	0
Cylindrotrichum proliferum	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	2	2	1	0	1	0	2	0	NC	1	1	0
Cylindrotrichum triseptatum	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	0	NC	1	0	1	0	2	0	NC	1	1	0
Cylindrotrichum zignöellae	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	2	1	1	0	1	0	2	0	NC	1	0	0
Dictyochaeta abnormis	1	NC	0	0	1	0	NC	NC	1	1	1	1	NC	NC	NC	NC	1	1	1	1	2	0	1	0	NC	0	0	0
Dictyochaeta apiculata	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1.5	1	1	1	2	0	1	0	NC	0	1	0
Dictyochaeta aristata	1	NC	0	0	1	0	NC	NC	1	0	1	1	NC	NC	NC	NC	1	1	1	1	1	0	1	1	1	0	0	0
Dictyochaeta assamica	1	NC	0	0	1	0	NC	NC	1	1	1	1	NC	NC	NC	NC	1	1	1	1	2	0	1	1	1	0	0	0
Dictyochaeta botulispora	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1	1	1	1	2	0	1	0	NC	0	1	0
Dictyochaeta brevisetula	1	NC	0	0	1	0	NC	NC	1	0	1	1	NC	NC	NC	NC	1	1	1	1	2	0	2	1	1	0	1	0
Dictyochaeta st. C. callimorpha	1	NC	0	0	1	0	NC	NC	1	1	1	1	NC	NC	NC	NC	1	1	1	1	2	0	1	0	NC	0	0	0
Dictyochaeta clavulata	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1.5	1	1	0	2	0	1	0	NC	0	0	0
Dictyochaeta coffeae	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1.5	1	1	1	2	0	1	1	1	0	0	0
Dictyochaeta cylindrospora	1	NC	0	0	1	0	NC	NC	1	1	1	1	NC	NC	NC	NC	0	NC	1	1	1	0	1	0	NC	0	1	0
Dictyochaeta dimorpha	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1	2	1	1	2	0	2	1	1	1	1	0
Dictyochaeta eucalypti	1	NC	0	0	2	0	NC	NC	0	NC	NC	0	NC	NC	NC	NC	0	NC	1	1	NC	0	2	1	1	0	0	0
Dictyochaeta fertilis	1	NC	0	0	1	0	NC	NC	1	1	1	1	NC	NC	NC	NC	1	2	1	1	2	0	1	1	1	0	1	0
Dictyochaeta fuegiana	1	NC	0	0	1	0	NC	NC	1	1	1	1	NC	NC	NC	NC	1	1	1	1	2	0	1	0	NC	0	0	0
Dictyochaeta gamundii	1	NC	0	0	1	0	NC	NC	1	1	1	1	NC	NC	NC	NC	1	1	1	1	2	0	1	1	1	0	1	0
Dictyochaeta heteroderae	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1.5	1	1	1	2	0	1	0	NC	0	0	0

TABLE 1. Cont....

Characters Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Dictyochaeta hughesii	1	NC	0	0	1	0	NC	NC	1	0	1	1	NC	NC	NC	NC	1.5	1	1	0	2	0	1	0	NC	0	0	0
Dictyochaeta illinoensis	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	0	NC	1	1	1	0	2	1	1	0	1	0
Dictyochaeta longispora	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1	1	1	1	2	0	1	1	1	0	0	0
Dictyochaeta lunata	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1.5	1	1	1	2	0	1	0	NC	0	1	0
Dictyochaeta lunulospora	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1	1	1	1	2	0	1	0	NC	0	1	0
Dictyochaeta matsushimae	1	NC	0	0	1	0	NC	NC	1	0	1	1	NC	NC	NC	NC	1	1	1	1	2	0	2	1	1	0	1	0
Dictyochaeta menisporoides	1	NC	1	1	3	1	1	1	0	NC	NC	0	1.5	2	0	2	1	1	1	1	2	0	1	1	1	0	0	0
Dictyochaeta novae-guineensis	1	NC	0	0	1	0	NC	NC	1	1	1	1	NC	NC	NC	NC	1	1	1	1	2	0	2	1	1	0	0	0
Dictyochaeta obesispora	2	0	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1.5	1	1	1	2	0	1	1	1	0	0	0
Dictyochaeta parva	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1	1	1	1	2	0	1	1	1	0	1	0
Dictyochaeta st. C. pulchriseta	1	NC	0	0	1	0	NC	NC	1	0	1	1	NC	NC	NC	NC	1	1	1	1	2	0	1	1	1	0	1	0
Dictyochaeta querna	1	NC	0	0	1	0	NC	NC	1	1	1	1	NC	NC	NC	NC	1	1	1	1	2	0	1	0	NC	0	0	0
Dictyochaeta septata	1	NC	0	0	1	0	NC	NC	1	1	1	1	NC	NC	NC	NC	1	1	1	1	2	0	2	1	1	0	0	0
Dictyochaeta setosa	1	NC	0	0	1	0	NC	NC	1	0	1	1	NC	NC	NC	NC	1	1	1	1	2	0	2	0	NC	0	1	0
Dictyochaeta simplex	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1.5	1	1	1	2	0	1	1	1	0	1	0
Dictyochaeta st. C. talbotii	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1	1	1	1	2	0	1	0	NC	0	0	0
Dictyochaeta tilikfrei	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1	1	1	1	2	0	1	1	1	0	0	0
Dictyochaeta triseptata	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1	1	1	1	2	0	2	1	1	0	0	0
Dictyochaeta unisetula	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1	1	1	1	2	0	1	1	1	1	1	0
Dictyochaeta vulgaris	1	NC	0	0	1	0	NC	NC	0	NC	NC	1	NC	NC	NC	NC	1	1	1	1	2	0	1	1	1	0	0	0
Gonytrichum caesium	1	NC	1	1	3	0	0	2	0	NC	NC	0	2	NC	1	2	0	NC	1	0	1	0	1	0	NC	1	1	1
Gonytrichum chlamydosporium	1	NC	0	1	3	1	1	1	0	NC	NC	0	2	NC	1	2	0	NC	1	0	1	0	1	0	NC	1	1	1
Gonytrichum macrocladum	1	NC	0	1	3	0	1	2	0	NC	NC	0	2	NC	1	2	0	NC	1	0	1	0	1	0	NC	1	1	1
Gonytrichum mirabile	1	NC	1	1	3	0	0	2	0	NC	NC	0	2	NC	1	2	0	NC	1	0	1	1	1	0	NC	1	1	0
Gonytrichum ypsilosporum	1	NC	0	1	3	0	0	2	0	NC	NC	0	2	NC	1	2	0	NC	1	0	1	1	1	0	NC	NC	1	1
Kionochaeta aristata	1	NC	0	1	3	1	0	1	0	NC	NC	0	2	2	0	1	0	NC	1	1	1	1	1	1	1	0	0	0
Kionochaeta ivoriensis	1	NC	0	1	3	1	1	1	0	NC	NC	0	2	2	0	2	0	NC	1	0	1	1	1	0	NC	1	1	1
Kionochaeta keniensis	1	NC	1	1	3	1	0	1	0	NC	NC	0	2	2	0	2	0	NC	1	0	1	0	1	1	1	0	0	0
Kionochaeta malaysiana	1	NC	0	1	3	1	1	1	0	NC	NC	0	2	2	0	2	0	NC	1	0	1	1	1	0	NC	0	0	0
Kionochaeta nanophora	1	NC	0	1	3	1	1	1	0	NC	NC	0	2	1	0	2	1	1	1	0	2	1	1	0	NC	0	0	0
Kionochaeta pughii	1	NC	1	1	3	1	1	1	0	NC	NC	0	2	1.5	0	2	1	1	1	0	2	1	1	0	NC	0	0	0
Kionochaeta ramifera	1	NC	1	1	3	1	0	1	0	NC	NC	0	2	2	0	2	0	NC	1	0	1	1	1	0	NC	0	0	0

TABLE 1. Cont....

Characters Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Kionochaeta spissa	1	NC	0	1	3	1	1	0	0	NC	NC	0	2	2	0	2	0	NC	1	0	1	1	1	0	NC	0	0	0
Kionochaeta virtuosa	1	NC	0	1	3	1	0	1	0	NC	NC	0	2	2	0	1	0	NC	1	1	1	1	2	0	NC	0	0	0
Menispora britannica	1	NC	0	0	1	0	NC	NC	1	0	1	1	NC	NC	NC	NC	1	1	2	0	2	0	1	1	1	0	0	0
Menispora ciliata	1	NC	0	1	3	1	0	2	0	NC	NC	0	2	2	0	1	0	NC	2	0	1	0	1	1	1	0	1	0
Menispora glauca	1	NC	0	1	3	1	0	2	0	NC	NC	0	2	2	0	1.5	0	NC	2	0	1	0	2	1	1	0	1	0
Menispora manitobaensis	1	NC	0	1	3	1	0	2	0	NC	NC	0	2	2	0	1.5	0	NC	2	0	1	0	2	0	NC	0	1	0
Menispora st. C. pulviscula	1	NC	0	1	3	1	0	2	0	NC	NC	0	2	2	0	1	0	NC	2	0	1	0	1	0	NC	0	0	0
Menispora tortuosa	1	NC	0	1	3	1	0	2	0	NC	NC	0	2	2	0	1.5	0	NC	1	0	1	0	2	1	1	0	1	0
Menispora uncinata	1	NC	0	0	1	0	NC	NC	1	0	2	1	NC	NC	NC	NC	1	1	2	0	2	0	1	1	1	0	0	0
Menisporopsis ludoviciana	2	1	0	0	1	0	NC	NC	2	1	1	1	NC	NC	NC	NC	0	NC	1	1	1	1	1	0	NC	1	1	0
Menisporopsis novae-zelandiae	2	1	0	0	1	0	NC	NC	2	0	1	1	NC	NC	NC	NC	1	1	1	1	2	0	2	1	1	0	0	0
Menisporopsis pleiosetosa	2	1	0	0	1	0	NC	NC	2	0	1	1	NC	NC	NC	NC	2	1	1	1	1	0	1	1	1	1	0	0
Menisporopsis profusa	2	1	0	0	1	0	NC	NC	2	0	1	1	NC	NC	NC	NC	1	2	1	1	2	0	1	1	1	0	1	0
Menisporopsis theobromae	2	1	0	0	1	0	NC	NC	2	0	1	1	NC	NC	NC	NC	0	NC	1	1	1	0	1	1	1	0	1	0
Zakatoshia hirschiopori	1	NC	0	0	2	0	NC	NC	0	NC	NC	0	NC	NC	NC	NC	0	NC	1	1	NC	0	1	0	NC	1	1	0
Zanclospora austroamericana	1	NC	0	1	3	0	0	1	0	NC	NC	0	1	NC	0	2	0	NC	1	1	1	1	1	0	NC	0	0	0
Zanclospora brevispora	1	NC	0	1	3	0	1	1	0	NC	NC	0	1	NC	0	2	0	NC	1	1	1	1	1	0	NC	0	0	0
Zanclospora novae-zelandiae	1	NC	0	1	3	0	0	1	0	NC	NC	0	1	NC	0	2	0	NC	1	0	1	1	1	0	NC	0	1	0

make up groups of OTU related by their grade of similarity.

A phenogram of 114 OTU was obtained by the aplication of the unweighted pair group method. In this method the cophenetic correlation coefficient (r) was computed as a measurement of distortion (Sokal & Rohlf, 1962).

RESULTS AND DISCUSSION

Figure 2 shows the 114 OTU phenogram. The similarity values are shown in the upper part.

In this phenogram there are two groups: the species with conidiogenous cells as part of the conidiophore are placed in the first group. This group is made up of 2 species of *Bahusutrabeeja*, 18 species of *Chloridium*, 12 species of *Cylindrotrichum*, 2 species of *Menispora*, 5 species of *Menisporopsis*, 35 species of *Dictyochaeta* and the monotypic genus *Zakatoshia*.

In the second group we can see the species with conidiogenous cells growing laterally or anphigenous on the conidiophore that may be sessile or on branches. In this group we can find the 7 species of *Chaetopsina*, 2 species of *Chaetopsis*, 8 species of *Codinaea*, 5 species of *Gonytrichum*, 9 species of *Kionochaeta*, 5 species of *Menispora* and 3 species of *Zanclospora*.

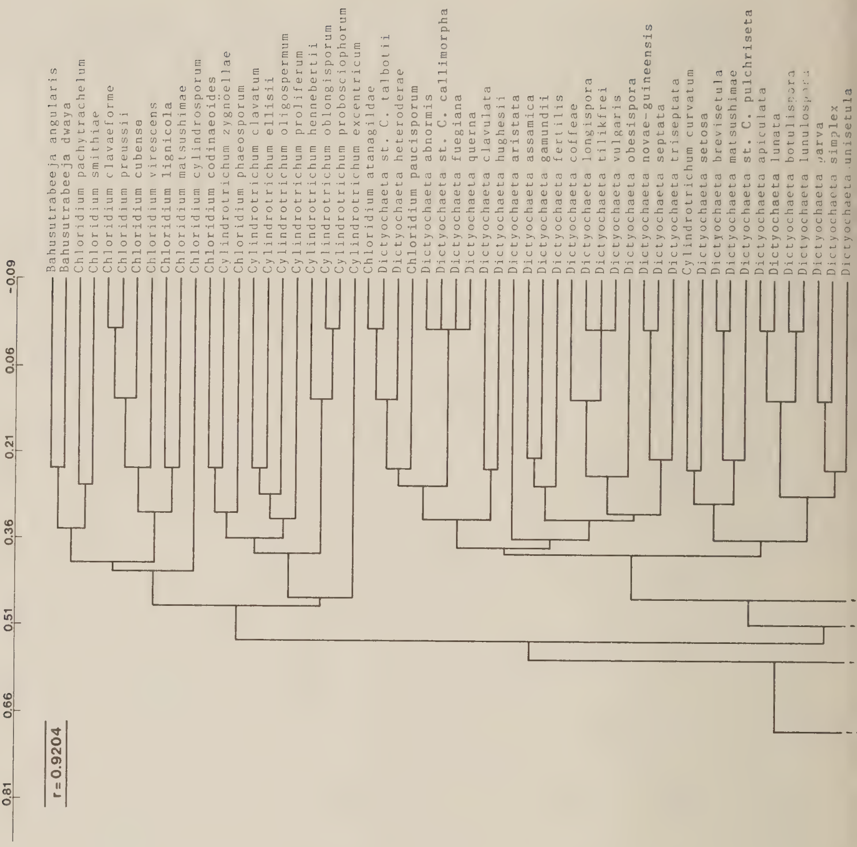
In the first cluster two species of *Bahusutrabeeja* and some species of *Chloridium* and *Cylindrotrichum* appear closely related.

In the characters we have gone through in this analysis the only differences are given by the shape and the ratio length/width of the conidia. In *Cylindrotrichum* the conidia are cylindrical and septate, the ratio L/W is larger than 1, instead of the species of the genus *Chloridium* where the conidia are 0-septate and the ratio L/W is near 1. The remaining characters, such as conidiophores and conidiogenous cells, are so similar between them that there is a correlation of the species of both genera. *Bahusutrabeeja angularis* and *B. dwaya* appear in this group because their conidiophores and conidiogenous cells are similar to those of *Chloridium* and *Cylindrotrichum* differing from them only by the conidial morphology. In the genus *Bahusutrabeeja* the conidia are rounded cubical, with one of the angles being the basal scar, and each corner provided with a thin hyaline appendage.

The *Dictyochaeta* cluster is related by the presence of the conidiophores with sympodial and/or percurrent proliferation, conspicuous collarette, cylindrical or ellipsoidal, curved and asymmetric conidia. In this same group we can also find *Chloridium atanagildae*, *C. paucisporum*, *Cylindrotrichum curvatum*, *Menispora britannica* and *M. uncinata* related to them. The presence of the above mentioned species is due to the characters which they show that relates them more to *Dictyochaeta* than to their own genera.

According to the author of the species (Holubová-Jechová apud Holubová-Jechová & Mercado, 1984), *Chloridium atanagildae* is distinguised from the rest of the *Chloridium*

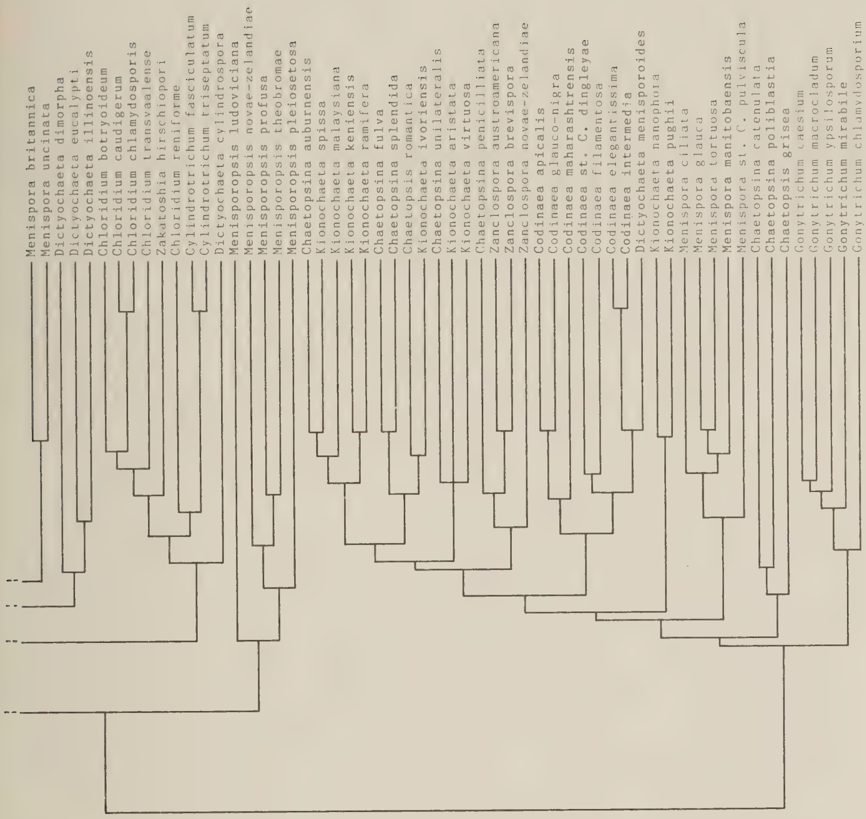
FIGURE 2. PHENOGRAM OF 114 OTU.



species by the presence of curved to lunate conidia, similar to those of the genus Dictyochaeta Speg. (=Codinaea Maire). She supports the idea that in Dictyochaeta the proliferation of conidiophores is percurrent, only seldom sympodial. We do not agree with this concept due to the presence of several sympodial proliferations in some species of Dictyochaeta (D. fertilis).

Chloridium paucisporum is related to Dictyochaeta by the sympodial proliferation and the presence of polyphialides and cylindrical and curved conidia. On the other hand the branched conidiophore are an unusual character of the genus Chloridium. Wilcox et al. (1974) were not completely sure of this and they tentatively identified it as species of Chloridium.

Cylindrotrichum curvatum is also found in this group because it has sympodial proliferation, polyphialides and curved conidia. DiCosmo et al. (1983) considered that C. curvatum is reminiscent of Dictyochaeta Speg. (=Codinaea Maire) and it would be necessary to propose a new genus for such "intermediate" species.


Menispora britannica
Menispora uncinata
Dictyochaeta dimorpha
Dictyochaeta eucalypti
Dictyochaeta illinoensis
Chloridium botryoideum
Chloridium caudigerum
Chloridium chlamydosporis
Chloridium transvaalense
Zakatoshia hirschiopori
Chloridium reniforme
Cylindrotrichum fasciculatum
Cylindrotrichum triseptatum
Dictyochaeta cylindrospora
Menisporopsis ludoviciana
Menisporopsis novae-zelandiae
Menisporopsis profusa
Menisporopsis theobromae
Menisporopsis pleiosetosa
Chaetopsina auburnensis
Kionochaeta spissa
Kionochaeta malaysiana
Kionochaeta keniensis
Kionochaeta ramifera
Chaetopsina fulva
Chaetopsina splendida
Chaetopsis romantica
Kionochaeta ivoriensis
Chaetopsina unilateralis
Kionochaeta aristata
Kionochaeta virtuosa
Chaetopsina penicillata
Zanclospora austroamericana
Zanclospora brevispora
Zanclospora novae-zelandiae
Codinaea apicalis
Codinaea glauco-nigra
Codinaea maharashtrensis
Codinaea st. C. dingleyae
Codinaea filamentosa
Codinaea elegantissima
Codinaea intermedia
Dictyochaeta menisporoides
Kionochaeta nanophora
Kionochaeta pughii
Menispora ciliata
Menispora glauca
Menispora tortuosa
Menispora manitobaensis
Menispora st. C. pulviscula
Chaetopsina catenulata
Chaetopsina poliblastia
Chaetopsis grisea
Gonytrichum caesium
Gonytrichum macrocladum
Gonytrichum ypsilosporum
Gonytrichum mirabile
Gonytrichum chlamydosporium

Dictyochaeta dimorpha, D. eucalypti and D. illinoensis are a very particular species of Dictyochaeta that have no setae accompanying the conidiophore.

D. dimorpha has two different kinds of conidiophores, one of them with polyphialidic conidiogenous cells with many sympodial proliferations and the other with monophialidic conidiogenous cells, each of them having a different conidial morphology. The former has 3-septate, setulate and straight conidia, whereas the latter has 0-septate or occasionally 1-septate, asetulate, slightly curved conidia. In the election of the characters we considered the species in the polyphialidic form with septate and setulate conidia.

In D. eucalypti the conidiogenous cells are terminal and intercalary without proliferations, and it has setulate, curved and septate conidia.

D. illinoensis has conidiophores without proliferations, the conidia are accasionally 1-septate, slightly curved, symmetric and bearing rudimentary setulae.

For such reasons these species of *Dictyochaeta* are less related with the other species of the genus.

Another group is made up by *Chloridium botryoideum*, *C. caudigerum*, *C. transvaalense*, *Zakatoshia hirschiopori*, *Chloridium reniforme*, *Cylindrotrichum fasciculatum*, *C. triseptatum* and *Dictyochaeta cylindrospora*. In these species the absence of proliferations either sympodial and/or percurrent is what relates them. The relationships between *D. cylindrospora* and the species of *Chloridium* and *Cylindrotrichum* mentioned above is not strange, since Morgan Jones (1976) stated: '*Codinaea cylindrospora* is not entirelly typical of *Codinaea* as defined by Hughes and Kendrick (1968) on account of the absence of phialidic proliferations, to produce polyphialides'. The absence of proliferation, and the non septate , straight and cylindrical conidia appear to relate *D. cylindrospora* with the species of the genera above mentioned. *Zakatoshia hirschiopori* also appear in this group by the absence of proliferation and the conidia similar to those of the *Chloridium*.

The species of the genus *Menisporopsis* appear related by the presence of synnematous conidiophores, the synnemate have central thick-walled setae.

The second group is featured by the conidiogenous cells growing sessile or in branches on the conidiophore. *Chaetopsina auburnensis*, *Kionochaeta spissa*, *K. malaysiana*, *K. keniensis*, *K. ramifera* make up a group related to another made up by *Chaetopsina fulva*, *C. splendida*, *Chaetopsis romantica* and *Kionochaeta ivoriensis*. Less related with these two groups we found *Chaetopsina unilateralis*, *Kionochaeta aristata* and *K. virtuosa*. *K. nanophora* and *K. pughii* which constitute a cluster, and *Chaetopsina catenulata*, *C. polyblastia* and *Chaetopsis grisea* which constitute another. Both are far from the other *Chaetopsina* and *Kionochaeta*, because they have sympodial or percurrent proliferation.

Chaetopsina and *Kionochaeta* include species with setiform conidiophore and conidiogenous cells growing on branches arranged at the apex, at the mid part of the conidiophore or with both dispositions, as in *K. pughii*. Kirk & Sutton (1985) concurred with Samuels (1985) and restricted *Chaetopsina* to the anamorph of the *Nectriaceae* with reddish-brown setose conidiophores that turn yellow with 100% lactic acid. When chose the characters we did not include neither the presence or absence of teleomorph nor the reaction with lactic acid because they are characters that were not studied in the majority of the species included in this analysis. However we wonder if these two characters used by Kirk and Sutton to separate both genera have sufficient taxonomical value to be used in such a way. On the other hand, what will happen with some species of *Kionochaeta* if new studies of the anamorph-teleomorph relationships result in them being anamorphs of a *Nectriaceae*?.

Chaetopsina penicilliata, *Zanclospora novae-zelandiae*, *Z. brevispora* and *Z. austroamericana* form another group. They share the following characters: conidiophores extending but not forming setae, a lageniform conidiogenous cells without proliferations. The presence of conidiogenous cells growing on apical branches is the difference between Chaetopsina penicilliata and the three species of Zanclospora. These species have sessile conidiogenous cells at the mid level of the conidiophore.

Codinaea apicalis, C. glauco-nigra, C. maharashtrensis,C. state of Chaetosphaeria dingleyae, C. filamentosa, C. elegantissima, C. intermedia and Dictyochaeta menisporoides make a group different from the other species of the genus Dictyochaeta because they have branched conidiophores and conidiogenous cells growing on them, they have conspicuous collarettes and the extension of the conidiophores may be straight or flexuose in Codinaea filamentosa. Morgan Jones et al.(1976) considered that C. apicalis and C. glauco-nigra could be separated in a new genus due to the characters last described. Holubová-Jechová (1984) consider that C. elegantissima, C. intermedia, C. filamentosa, Dictyochaeta menisporoides, C. state of Chaetosphaeria dingleyae, and C. maharashtrensis are in similar situation.

Menispora ciliata, M. glauca, M. tortuosa, M. manitobaensis and M. state of Chaetosphaeria pulviscula share the following characters: conidiogenous cells uncinate without proliferations and growing on the conidiophores. M. britannica and M. uncinata differ from the above mentioned Menispora because they have the conidiogenous cells integrated to the conidiophore; they have sympodial proliferations and independent setiform structures, due to this reasons they are closely related to Dictyochaeta in the first group. Nevertheless they have conidiogenous cells abruptly and strongly recurved towards the conidiophorous axis so that a poorly differentiated tubular collarette is directed towards the base of the phialide (uncinate). For this characters Hughes & Kendrick (1968) and Kirk (1985) considered them in Menispora.

The species of the genus Gonytrichum form a cluster. The presence of conidiophores bearing one or several short, curved, lateral branches (collar hyphar) below the septa from which cluster of phialides arise appearing verticilliate and the conidiophore extending forming or not a setae, are the characters that we only find in the species of this genus.

CONCLUSIONS

From the analysis of the results we can conclude:

The genus Dictyochaeta is well defined. Codinaea apicalis, C. state of Chaetosphaeria dingleyae, C. elegantissima, C. filamentosa, C. glauco-nigra, C. intermedia, C. maharashtrensis and Dictyochaeta menisporoides need a different treatment. For this reason we remaing them in Codinaea.

Bahusutrabeeja, Chloridium, Cylindrotrichum and Zakatoshia are genera very related and the differences between them are based only on the morphology of the conidia, and sometimes these differences are so minute that it is difficult to find them.

Menispora britannica and M. uncinata must be reconsidered their systematic position in Menispora or Dictyochaeta.

Menisporopsis is a good genus with well defined characters. The same happens with Gonytrichum and Zanclospora.

The considerations about Chaetopsina and Kionochaeta are in the results. Probably both genera must be reconsidered.

The two species of Chaetopsis considered in this analysis appear clustered with different species of Chaetopsina and Kionochaeta and need a revision.

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THE GENUS CLADIDIUM (LICHENIZED ASCOMYCOTINA)

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ABSTRACT. The dwarf fruticose lichens of Lecanora sensu lato described by Tuckerman from coastal California are revised, with emphasis on the genus Cladidium Hafellner. The new combination **Cladidium bolanderi (Tuck.) Ryan** is made, with C. thamnitis (Tuck.) Hafellner treated as a synonym. These taxa and Lecanora phryganitis Tuck. are lectotypified.

INTRODUCTION

The dwarf fruticose species of Lecanora Ach. sensu lato described by Tuckerman (1864, 1866) from coastal California have not been investigated in much detail previously. The purposes of the present paper are: 1) to clarify the supraspecific classification of Lecanora bolanderi Tuck. and Lecanora thamnitis Tuck.; 2) to provide detailed descriptions of these taxa; 3) to discuss the relationships of these taxa to each other and to another species, Lecanora phryganitis Tuck. (to be discussed in more detail in a separate article) in relation to the lectotypifications made in this study.

METHODS AND TERMINOLOGY

In the descriptions of the species below, the following items should be noted: numbers given in parentheses after colors refer to Kelly (1965); colors of the thallus and apothecia are as seen under a dissecting microscope (American Optical Spencer with fluorescent lighting, at 40x). More critical observations of external morphology were made with a Zeiss dissecting microscope with fiber optic lighting. Unless stated otherwise, observations and measurements of spores, hyphae, etc. were made on wet mounts, using an Olympus model BHB microscope. Crystalline deposits were observed using polarized light (crossed Nichol filters). Most sections were made by hand and mounted in water or lactophenol-cotton blue for semi-permanent slides (coverslip attached on one side by plastic cement). Photomicrographs of selected hand-sectioned, gold-coated specimens were made with a scanning electron microscope with the help of Mason Hale and a technician at the Smithsonian Institution.

The chemical analyses reported here were made by the standard thin-layer chromatographic method using the three main solvent systems of Culberson (1972), with substitution of methyl tertiary-butyl ether for diethyl ether in system B (Culberson, 1982) (= B') and substitution of toluene for benzene in system A (Culberson, et al., 1981). The chemistry of several specimens was also analyzed by C. Leuckert, using lichen mass spectrometry.

Spot tests and anatomical observations were made using the following reagents: 10% aqueous potassium hydroxide solution (K), freshly prepared dilute alcoholic solution of paraphenylenediamine (Pd), sodium hypochlorite solution in the form of household bleach (C), concentrated nitric acid (N), and iodine-potassium iodine solution (I_2KI). Chlor-zinc-iodine solution, which stains for cellulose, was used for detecting empty algal cells, after pre-treatment in KOH and flushing with water.

Voucher specimens are deposited in the Arizona State University herbarium (ASU) unless otherwise cited. Herbarium abbreviations follow those in Holmgren & Keuken (1974): ASU, CANL, COLO, DAV, FH, G, GZU, H, IRVC, LAM, M, SFSU, UC, UPS, US, WU. Nomenclature of lichen taxa mentioned in this article, other than the fruticose Lecanoras, follows Egan (1987).

Most of the terminology employed in the descriptions follows the usage of Eigler (1969). A few of the terms used in the present article need further explanation: 1) "spermogonia" and their "spermatia" are used here because it is likely that the very slender "pycnospores" which contain very little cytoplasm function in sexual reproduction rather than as asexual "conidia"; 2) the "hypothecium" is regarded here as the lower part of the excipulum, and "subhymenium" is used for the ascogenous layer between the hypothecium and the hymenium; and 3) "epithecium", which properly applies only to a plectenchyma, is replaced here by "epihymenium" for the upper part of the hymenium and "epipsamma" for granular material in or on top of the hymenium.

SUPRASPECIFIC CLASSIFICATION

Tuckerman's concept of Lecanora sect. Cladodium (which he mentioned in 1872 and defined in 1882) included all three of his coastal Californian fruticose taxa, L. bolanderi, L. phryganitis and L. thamnitis, and was based only on the "fruticulose" form of the thallus, sessile apothecia and simple spores. Zahlbruckner (1907; 1926) gave a slightly more detailed description of the section, including the misleading statement that the thallus is "unberindet" (ecorticate). In his classification system, Rasanen (1943) included "Cladodium Tuck." as a genus, but he cited neither individual species nor the basionym (Lecanora sect. Cladodium Tuck.) and therefore did not validly publish a new combination for it as a genus.

Hue (1909a) described the genus Polycauliona, based mainly on growth form, and he gave as the synonym "Placodium sect. Thamnonoma Tuck." [= Caloplaca sect. Thamnoma (Tuck.) Zahlbr.]. Hue (1909b) transferred Lecanora bolanderi, L. phryganitis and L. thamnitis (along with other species) to Polycauliona, and this time also included Lecanora sect. Cladodium among the synonyms. Both Zahlbruckner (1901-1914) and Poelt & Pelleter (1984) argued that Polycauliona is a heterogenous and unnatural group. Although Polycauliona needs to lectotypified, the name was originally based on a group of species now in Caloplaca and therefore cannot be used as a genus for Tuckerman's fruticose Lecanoras.

Gyelnik (1934) raised Lecanora sect. Cladodium Tuck. to the level of genus, citing Tuckerman (1872). However, he explicitly mentioned only Cladodium Hosseanum Gyelnik (isotype at M! = Rhizoplaca cf. melanophthalma), which was not included in the protologue of the basionym and therefore cannot be the lectotype species of Lecanora sect. Cladodium. According to the Code (Voss, et al., 1983; Articles 64.1 and 45.3) Gyelnik's genus Cladodium must be rejected as a later homonym for the moss genus Cladodium Bridel (1826).

Eigler (1969), in his treatment of Lecanora sensu lato, suggested that (based on various anatomical features) the "L. thamnitis group" should be a separate genus, but he did not formally propose a new combination. He explicitly cited L. thamnitis as type species of Lecanora sect. Cladodium, but did not cite particular specimens, nor did he mention L. bolanderi or L. phryganitis.

Hafellner (1984) used the genus Cladidium as nomen novum for Cladodium Gyelnik (1934), cited Lecanora sect. Cladodium Tuck. (1866) as a synonym, and changed the "o" in Cladodium to an "i" to legitimize it as a genus. He explicitly cited L. thamnitis as the type species of the genus Cladidium and as Eigler's lectotype of Lecanora sect. Cladodium. Hafellner stated that in contrast to L. thamnitis, in which the ascus tips have a very wide axial mass (similar to that found in Candelariaceae), L. bolanderi has a typical Lecanora-type ascus and should be excluded from the genus Cladidium. The specimen of L. thamnitis he cited was Reliq. Tuck. 116 (GZU!), which is an isolectotype of that species (see below). Hafellner based his concept of "L. bolanderi" on a misidentification of L. phryganitis. However, based on the lectotypes chosen below, true L. bolanderi belongs in the genus Cladidium, and L. thamnitis is treated here as a synonym of L. bolanderi.

Relationship of Cladidium Hafellner to Other Taxa

At present the genus Cladidium appears to have no obvious close relatives. The distinctive thallus anatomy of L. bolanderi and L. thamnitis (alternation of dense fungal tissue with loose algal tissue--Fig. 1) helps to separate Cladidium from Lecanora. However, a similar structure occurs in most fruticose species of Caloplaca (e.g., C. coralloides), is common in various otherwise dissimilar lichens of coastal and xeric habitats, and probably has an adaptive function connected with water relations (Poelt & Pelleter, 1984). A less extreme form of this anatomical type (confined to the upper layers of the thallus) occurs in some lobate crustose Lecanora species.

Lecanora phryganitis (which often occurs side by side with Cladidium and with Caloplaca coralloides), is however quite different in thallus anatomy (Fig. 2) as well as other features (Table 2) and belongs in a natural group with L. pinguis Tuck. (type species of Lecanora subg. Placodium sect. Endochloris, described by Poelt [1958]). Lecanora phryganitis is excluded from Cladidium, and is treated in similar detail in a separate paper as:

Lecanora phryganitis Tuck., Lich. Calif. p. 19 (1866).
Type (from the protologue): "On sandstone rocks, coast; Mr. Bolander." **Lectotype (selected here):** "...on metamorphic sandstone, near the Mission Dolores ... 1/12/64", Bolander 63, (FH!) (Figs. 3-4).

Polycauliona phryganitis (Tuck.) Hue, Compt. rend. congrès Soc. Sav. en 1908: 153 (1909b).

DESCRIPTION OF THE TAXA

Cladidium Hafellner, Beih. f. Nova Hedw. 79: 296 (1984). Nomen novum for Cladodium (Tuck.) Gyelnik. **Lectotype species (Hafellner, 1984):** L. thamnitis Tuck. (1866).

Lecanora sect. Cladodium Tuck., Synopsis N. Am. Lich. 1: 181 (1882). **Lectotype species (Eigler, Diss. bot. 4: 169 [1969]):** L. thamnitis Tuck. (1866).

Cladodium (Tuck.) Gyelnik , Repert. Spec. Nov. Veg. 33: 305 (1934), non Bridel (1826)!

Cladidium bolanderi (Tuck.) Ryan, comb. nov. (Figs. 1, 5-12)

Lecanora (Squamaria) Bolanderi Tuck., Proc. Amer. Acad. Arts Sci. 6: 266 (1864). **Type (from the protologue):** "On rocks ('metamorphic sandstone') in Marin County, California, Mr. H. N. Bolander." **Lectotype (selected here):** "On metamorphic sandstone, Marin Co.", undated, Bolander 29 [specimen on card] (FH!).

Polycauliona Bolanderi Hue, Compt.-rend. congrès Soc. Sav. en 1908: 153 (1909b).

Lecanora thamnitis Tuck., Lich. Calif.: 20 (1866).
Type (from the protologue): "Sandstone rocks...Mr. Bolander." **Lectotype (selected here):** Oakland Hills, undated, Bolander, s.n., Reliq. Tuck. 116 (FH!); **Isolectotypes:** (COLO!: 2 packets, GZU!, UC!).

Polycauliona thamnitis (Tuck.) Hue, Compt.-rend. congrès Soc. Sav. en 1908: 153 (1909b).

Cladidium thamnitis (Tuck.) Hafellner, Beih. f. Nova Hedw. 79: 296 (1984).

Description of Cladidium bolanderi:

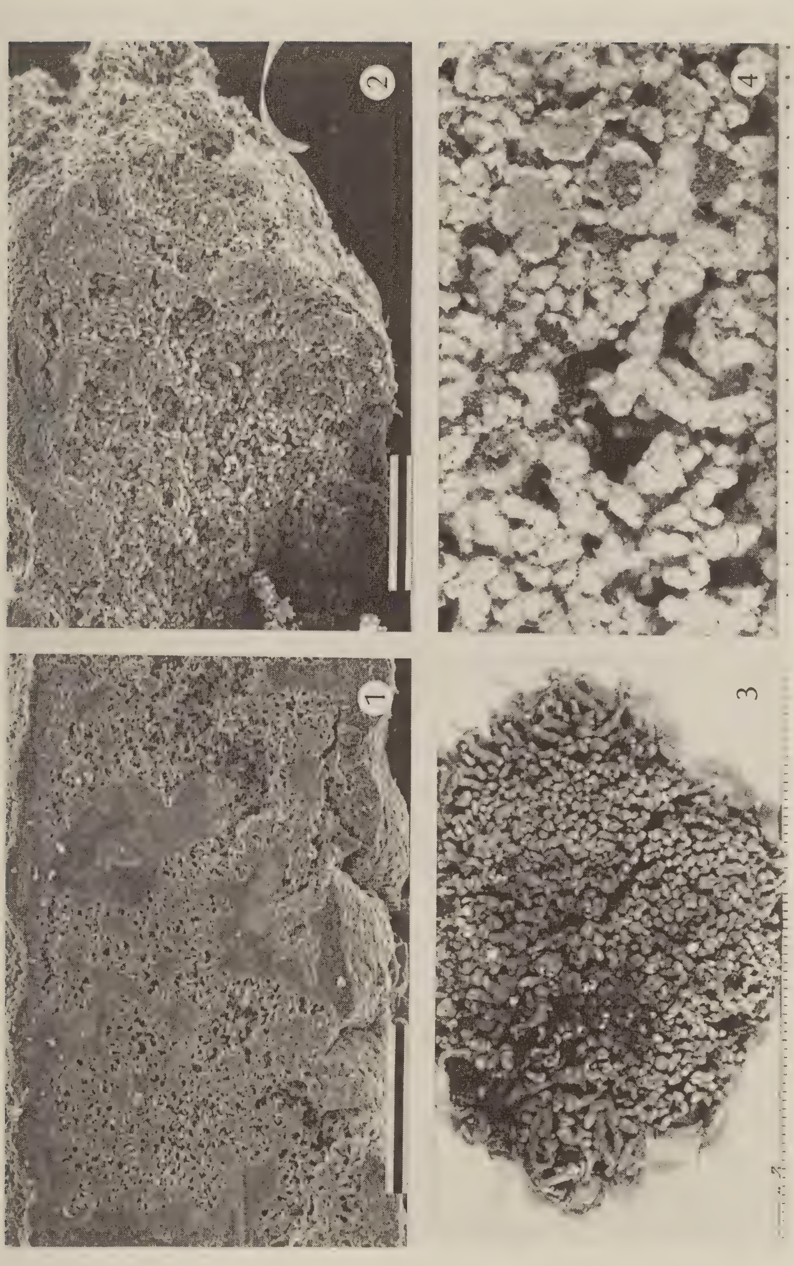
THALLUS: Dwarf fruticose, caespitose. Starting as small granules or verrucae. In the typical and most widespread form, becoming loosely tufted, much branched ± dichotomously, the branches erect (or decumbent towards thallus margin), forming irregularly rounded "sods" (to 2-10 cm across) which are continuous to fissured and have an uneven surface (Figs. 7-8). In "*L. thamnitis*" form, branches densely crowded, mostly erect and similar in height, giving patches a more even surface; forming either extensive crustlike mats without definite margin (Fig. 10), or discrete hemispherical to irregular peltate clumps 5-15 mm diam. (Fig. 11), with branches radiating from a central main trunk, attached to rock by a single irregular area 1-4 mm wide. **Branches:** Terete, to irregularly compressed near thallus margin (or terete throughout in "*L. thamnitis*"), 5-10(-15) mm, irregularly thickened (0.5-1 mm), tips papilliform (usually scarcely widened, 25-50 per cm^2; narrower and up to 100-200 per cm^2 in "*L. thamnitis*"). **Surface:** Matt; continuous and ± even, not verrucose or granular, but pale spots often slightly raised and roughened; without vegetative propagules. **Color:** Basic color mostly light to dark grayish olive (109-111) or grayish greenish yellow (105), with irregularly shaped pale whitish or yellowish areas (pseudocyphellae or maculae in the broad sense), especially toward lobe tips (in "*L. thamnitis*", mainly the strongly whitened branch tips are visible from above). Little changed when wet. Undersides and basal parts mostly pale yellowish green (121), pale to moderate yellow (87, 89) to moderate orange-yellow (71) or moderate yellowish brown (77), without pale spots. In old herbarium specimens, turning moderate orange (53) to various shades of brown (55-56) or yellowish brown (74-75), paler below, darker and more grayish towards base. **Consistency:** Cartilaginous, brittle but not crumbly.

APOTHECIA: Usually common; 0.5-4 mm diam., terminal or subterminal, sessile to somewhat constricted at base (in "*L. thamnitis*" appearing to be partly immersed within thallus patch). **Disc:** Concave to plane; usually yellowish to whitish or grayish pruinose (at least when young); mostly various shades of yellow (86-87, 101) or yellowish brown (75, 77) under pruina, little changed when wet. Sometimes turning blackish or reddish due to parasites. **Margin:** Usually swollen (to 0.5 mm thick); entire or (especially in *L. thamnitis*) becoming crenate and irregularly lobed; even with disc or somewhat raised and inflexed when young; persistent. Concolorous with upper parts of thallus, usually strongly pale spotted and somewhat roughened above. No proper margin visible.

SPERMOGONIA: Present on or near tips of branches; completely immersed; ostiole pale. Cavity 150-200 µm diam. in section; wall hyaline. **Spermatia:** Threadlike, curved, (12-)15-25 µm (based on *Jordan 3447* [GZU], *Bolander, s.n.* [H-Nyl. 28323], *Setzer 697*, *Ryan 21968*).

THALLUS ANATOMY: Thallus composed of irregular areas of dense medullary tissues, alternating with loose tissues mostly containing algae; with network of irregular elongated areas appearing opaque due to yellowish granules (K-insoluble), partly associated with algae. **Cortex:** True cortex (without empty algal cells); continuous; *ca.* 25-45 µm thick; inspersed toward outside with yellowish granules (partly soluble in K). Hyphae mostly anticlinal, otherwise similar to those of medulla. With 2-3 µm thick epinecral layer. **Algae:** Algal cells Trebouxioid, 7.5-10(-15) µm diam.; arranged in irregular, often radially elongated clumps in areas of optimal light, occurring within areas of loosely arranged tissue with gaps in it (aerenchyma), which consist of hyaline, thin-walled hyphae (*ca.* 2 µm diam.) and penetrate to the surface as pseudocyphellae. **Medulla:** Prosoplectenchymatous (scleroplectenchymatous); hyphae densely interwoven and agglutinated, irregularly thick-walled, *ca.* 2 µm diam., with indistinct outer boundaries, non-granular yellow-orange wall pigmentation, and distinct lumina.

APOTHECIAL ANATOMY: "*Thamnitis*-Typ" of Eigler (1969--Plate 25: 3). **Hymenium:** "*Thamnitis*-Typ" of Eigler (1969--not illustrated), (50-)70-90(-100) um high, colorless below, not inspersed. Epihymenium pale; epipsamma 10-20 um thick, mostly superficial, composed of yellowish granules (partly soluble in K). **Spores:** Ellipsoid to oblong-ellipsoid or ovoid-ellipsoid (L:W = 1.5-2.5:1), mostly (8-)10-14(-16) x 5-6(-8) µm; moderately thin-walled; mostly uniseriate, 8 per ascus; simple, usually with one or two oil drops. **Asci:** Clavate to subcylindrical, *ca.* 50 x 8-12 µm; outer wall layer and gelatin strongly amyloid, tips with amyloid ring, with axial mass very



Figs. 1-2. Scanning electron micrographs of longitudinal sections of branches. Scale = 200 µm. -1. Cladidium bolanderi (Tuck.) Ryan: typical morphotype (Krypt. exs. Vindob. 1870, US). -2. Lecanora phryganitis Tuck. (COLO Exs. 475, US). -3,4. Morphology of L. phryganitis. Parts of lectotype (Bolander 63, FH). Scale = mm.

broad toward the outside and appearing almost non-amyloid (based on Reliq. Tuck. 116 [FH], Bolander, s.n. [H-Nyl. 28323], Setzer 697). **Paraphyses:** "Atrynea-Typ" of Eigler (1969--Plate 17: 33); simple to furcate; septate; 1-1.5 µm thick below; apical cells only slightly thickened (to 2-2.5 µm), colorless, thin-walled; somewhat loosely coherent, not strongly gelatinized. **Subhymenium:** About 50 µm thick, colorless. **Excipulum: Hypothecium:** To 500 µm thick, of agglutinated hyphae with threadlike lumina, randomly oriented to mostly anticlinal, colorless to yellow-orange, not inspersed. **Parathecium:** 25-90 µm thick, of parallel hyphae. **Amphithecium:** Structure similar to that of thallus. **Cortex:** About 50 µm thick. **Algal Layer:** Present in margin and below hypothecium; to 65 µm thick, divided into clumps of algal cells.

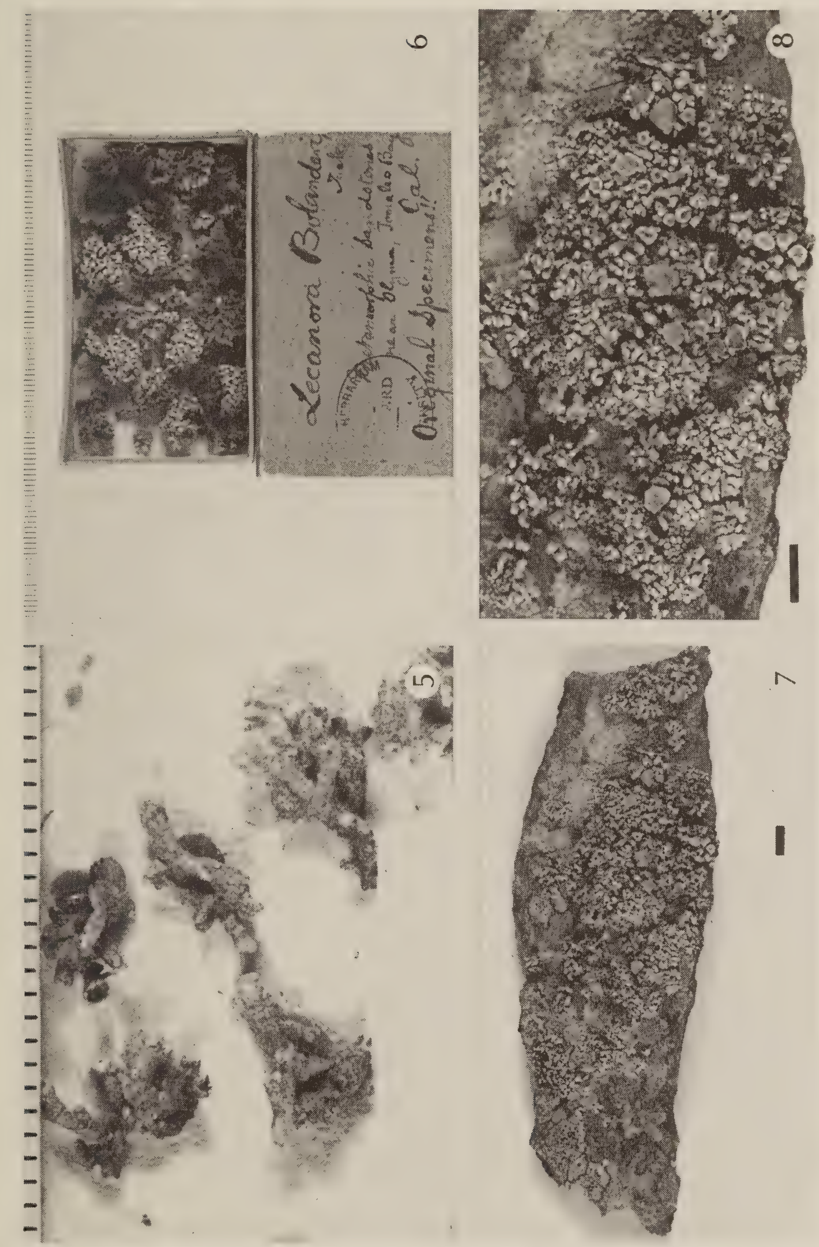
SPOT TESTS: Cortex: C-; partly K+ yellow; KC+ yellowish; Pd-; N-. **Medulla:** C-; K-; KC-; Pd-; N-; I_2KI-. **Discs:** C-; K-; Pd-.

CHEMISTRY: Usnic acid or isousnic acid (occasionally both), usually with several unknown (probably phenolic) substances found by thin-layer chromatography (Table 1), in almost all possible combinations ("L. thamnitis" morphotype usually contains usnic acid and unknown CBL-1, but "L. bolanderi" morphotype shows more variability, often containing isousnic acid and unknown CBL-2). Report of usnic acid, arthothelin and thiophanic acid from L. bolanderi (Santesson, 1969) is based on L. phryganitis (specimen annotated by Santesson not seen).

Table 1. Partial list of secondary metabolic substances found in Cladidium bolanderi sensu lato (including "Lecanora thamnitis"). Data are from thin-layer chromatography, based on the method of Culberson (1972), with substitution of toluene for benzene in solvent system A and methyl-tert.-butyl ether for diethyl ether in solvent system B (=B'). Numbers after colors in "Color after acid" column refer to Kelly (1965).

R_FClasses			Substance	UV (LW)	Color after acid charring	UV (LW) after charring
A	B'	C				
2-3	2	2	CBL-1	light violet [210]	yellowish gray (faint)[93]	dark greenish gray [156]
4	2-3	3	CBL-2	grayish brown [61]	light yellow [86]	grayish brown [61]
5-6	6	6	CBL-3			very light green [143]
5	5	5	CBL-4			light orange yellow [70]
6	6	6	Usnic acid	quench	light to dark greenish gray [154-155]	quench
7	7-8	7	Isousnic acid	quench	grayish olive [109-110]	quench

ECOLOGY: On siliceous or ultramafic rocks (sandstone, chert, granite, serpentine), on horizontal to steep but not overhanging surfaces, often on large, exposed boulders on bluffs near the seashore, 20-550 m elev. ("L. thamnitis" may be more common at upper end of this range). Probably strongly nitrophilous; sometimes on rocks covered by guano. **Associated organisms:** Associated vascular plant communities, include Umbellularia-Quercus chaparral and mixed grassland. Associated lichens include: Lecanora phryganitis, L. pinguis, L. muralis, Arthonia phaeobaea, Buellia spp., Caloplaca rosei, C. coralloides, Lecidella subincongrua, Niebla spp., Phaeophyscia


5
6
7
8
Lecanora Bolanderi
Tuck.
Cal.
Original Specimens!!

Figs. 5-8. Cladidium bolanderi (Tuck.) Ryan: typical morphotype. -5. Lectotype of Lecanora bolanderi Tuck. (Bolander 29, FH: specimen attached to card). Scale = mm. -6. Box labelled "original specimens! (Bolander, s.n., FH). -7,8. Representative thalli attached to rock (Ryan 21968, ASU). Scale = 5 mm.

spp., Physcia spp., Punctelia stictica, Xanthoria candelaria, and sometimes Collema spp. or Verrucaria cf. maura. Hymenium and apothecial margins sometimes eaten by snails. Often with numerous black mites (Acarina) within the thallus clumps. Often with black ascocarps (Arthonia sp.) and red areas on the thallus and discs (unidentified parasite).

DISTRIBUTION: USA: Central California, north to southern Oregon. Report of L. thamnitis from Alaska by Calkins (1899--specimen not seen) is probably erroneous.

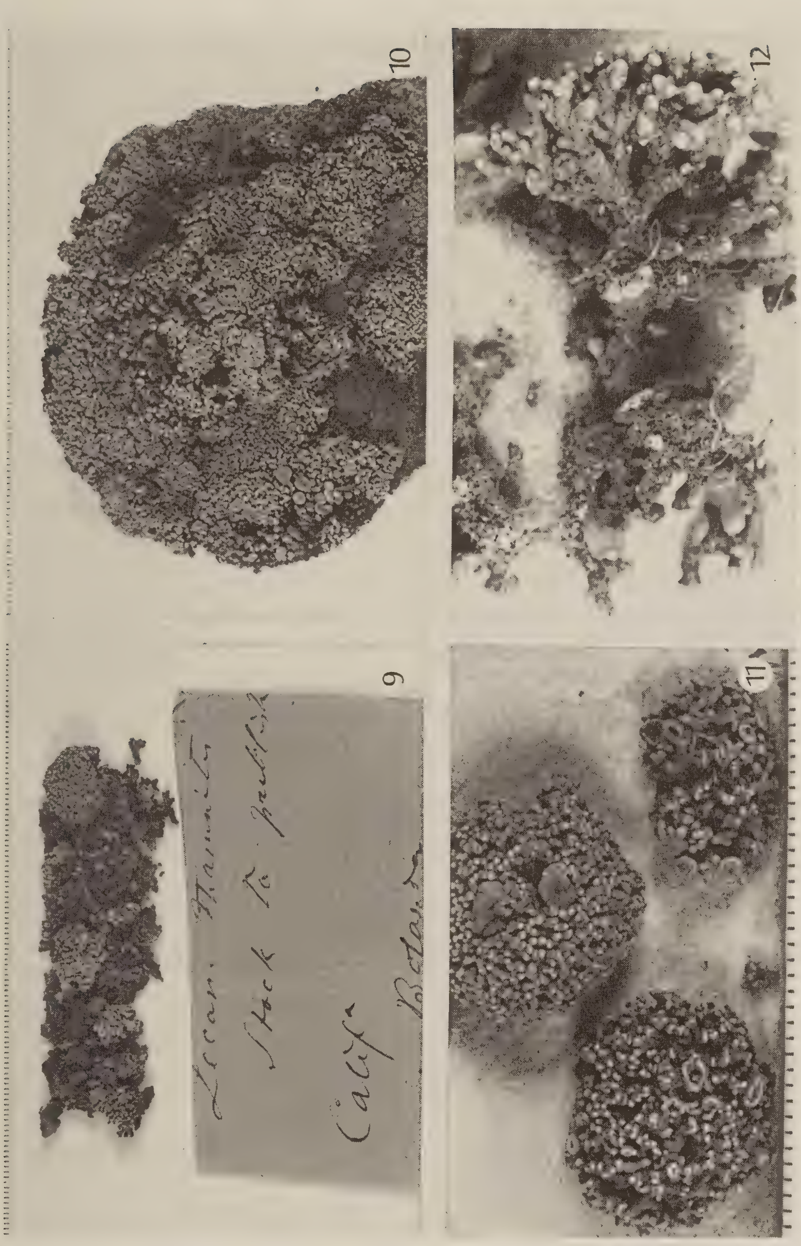
ADDITIONAL LITERATURE REPORTS: See Zahlbruckner (1921-1940) and Tucker and Jordan (1979) for numerous citations; also see Weber (1981).

EXSICCATI: USA: CALIFORNIA: San Mateo Co.: (Pigeon Pt.): Krypt. Exs. Vindob. 1870, Herre, s.n. (FH, G, M, US, WU seen); **Alameda Co.: (Oakland Hills):** Reliq. Tuck. Exs. 116 (lectotype of L. thamnitis: FH; isolectotypes: COLO: 2 packets; FH; GZU and UC seen).

OTHER SPECIMENS EXAMINED: Unless stated otherwise, all specimens listed below were originally labelled as L. bolanderi and are ± representative of that morphotype.

USA: CALIFORNIA: Alameda Co.: (Oakland Hills): Bolander 125 (L. thamnitis)(FH); Bolander, s.n., undated (L. thamnitis) (FH; M). **Marin Co.:** Bolander 29 (lectotype of L. bolanderi: FH--specimen on card); Bolander, s.n., undated (COLO L-10312; FH; UC 666809); Bolander, s.n., 1867 (FH); Murray, s.n., 4.28.1982 (SFSU); **(Vicinity of Stinson Beach):** Parks L-104 (COLO S-6136; UC); Parks 2697 (UC); Peters 9168 (SFSU); Weber & Kunkel L-60850 (COLO); **(Between Pt. Reyes & Inverness):** Weber 75-93 (DAV); **(1 mi E of Jct. Nicasio-Pt. Reyes Rd.):** Weber & Kunkel L-60804 (COLO; M; US: 2 packets); **(Hill E of Muir Woods):** Wennekens 64 (SFSU); **(Mt. Tamalpais State Park):** Riefner 84-75 (IRVC); **(Ft. Cronkite):** Setzer 697 (ASU, SFSU); **(Road to Stinson Beach):** Ryan 21967, 21968; **(Rocky Pt.):** Volk 842 (SFSU); **(Olema):** Bolander, s.n., Tamales Bay, "Original Specimens!" (FH); Bolander, s.n. (H-Nyl. 28322), Bolander, s.n., 1864 (FH; UC 43264), Howe 15, (UC 528927; US; specimen at FH contains no Cladidium), Bolander, s.n., 1868, "Boulders near Olyma [sic]" (G: 2 packets); **(Pt. Bonita):** Riefner 85-707 (COLO). **Monterey Co.: (Monterey):** Farlow, s.n., "Journey to California, 1885, Monterey" (as L. phryganitis) (FH: 4 packets; G; UPS); **(Pt. Lobos):** Ryan 21955 (ASU). **San Francisco Co.: (Farallone Islands):** Foreman, s.n. (COLO L-44,400); Lindahl, s.n., 1886 (UPS); Tenaza 15526 (SFSU); Wheeler, s.n., June 1895 (UC 43266 & 43265); **("San Francisco"):** Bolander, s.n., 1867, "Californie" [sic], as L. thamnitis (G), Bolander, s.n., 1868, as L. thamnitis (G: 2 packets), Bolander, s.n., undated, (G), Bolander, s.n.? (51 on box inside), 1865 (US). **San Luis Obispo Co.: (Morro Rock):** Riefner 87-460 (IRVC; COLO). **San Mateo Co.: (San Bruno Mt.):** Bolander 155 (as L. thamnitis) (FH); Herre 834 (FH; US: 2 packets); **(Pigeon Point):** Herre 1308, (US); Herre, s.n. (715?), 1933 (US); **(1 mi S of Pacifica City):** Jordan 9 (SFSU); **(near Pt. San Pedro):** Herre 506 (FH: 2 packets); Setzer 1953 (SFSU). **Sonoma Co.:** Jordan 3447 (GZU); Jordan 3461 (GZU); **(near Jenner):** Koch 479 (UC: 2 packets); Halling 727 (SFSU); **(Ft. Ross Historical Park):** Riefner 85-608 (IRVC); **(Goat Rock State Park):** Riefner 86-142 (IRVC; COLO); **(Duncan's Landing.):** Halling 1296 (SFSU); Riefner 85-621 (IRVC); Riefner 86-159 (IRVC; COLO); **(Carlevaro Rd.):** Riefner 86-209 (IRVC); Riefner 85-625 (IRVC; COLO). **No Locality Given:** Bolander, s.n., undated, "ex. Willey herb." (as L. thamnitis) (FH); Bolander, s.n., 1865, "Coast of California" ("L. thamnitis", p.p.) (US); Hall, s.n., 1884 (US); Herre, s.n., State Survey X-18 ("L. thamnitis", p.p.) (UC 208852); Bolander, s.n., (H-Nyl. 28323); Bolander, s.n., "ex Willey Herb." (FH). **("San Francisco Watershed"):** Thiers 15245 (SFSU). **OREGON: Curry Co.: (Harris Beach State Park):** Cooke 26803 (LAM); Cooke 26808 (LAM).

VARIABILITY: Within Cladidium bolanderi sensu lato, variations occur in color and surface texture, morphology of branches and apothecia, size and shape of spores, and chemical content. These variations, which often occur side by side, show no obvious correlations with each other or with ecological factors, but more field study would be desirable. The two main morphotypes ("L. bolanderi" and "L. thamnitis"), their relationships to L. phryganitis, and the typification of these taxa, are discussed below.


10
12
9
Lecan. thamnitis
Stuck to pebbles
Calif.
Bolander
11

Figs. 9-12. Cladidium bolanderi (Tuck.) Ryan: "Lecanora thamnitis" morphotype. Scale = mm. -9. Lectotype of L. thamnitis Tuck. (Reliq. Tuck. exs. 116, FH). -10. Representative thalli attached to rock (Bolander, s.n., Oakland Hills, FH). -11 . Peltate thalli (Bolander 125, FH). -12. Detail of branches from San Bruno Mountain collection (Bolander 155, FH).

DISCUSSION

Relationships Among the Coastal Fruticose Lecanoras

Tuckerman's protologues distinguish L. phryganitis from the other two taxa by spore shape, position of the apothecia, and form and color of the thallus (Table 2). Later (1872) he stated:

> "...in L. phryganitis...we have neither the peltate fronds of L. Bolanderi, nor the effuse crust of L. thamnitis, but dense patches, made up, at the centre, of crowded erectish trunks, which are elongated, at the circumference, into finally decumbent branches."

My own study shows that the characteristics of L. phryganitis mentioned by Tuckerman may be correlated with other characters (Table 2), which make it very closely related to the lobate crustose species Lecanora pinguis Tuck., in spite of the conspicuous difference in growth form. In contrast, the characteristics originally observed by Tuckerman for L. bolanderi and L. thamnitis positively correlate with others, some of which (at least the ascus type) are sufficient for recognition of a separate genus for them, as discussed above.

Although L. bolanderi and L. phryganitis have often been confused with each other, the protologues of the three fruticose taxa, as well as Tuckerman's later comments (1872, 1882) and his annotations of specimens (see below) strongly suggest that Tuckerman applied the name L. bolanderi to material more similar to L. thamnitis than to L. phryganitis.

Table 2 also compares L. thamnitis and L. bolanderi. Tuckerman's protologue of L. thamnitis stated that his new species was similar to Cladonia papillaria (now in Pycnothelia) and Lecanora aipospila (now in Lecania), both of which form mostly effuse, papillate crusts. Tuckerman's protologue of L. bolanderi noted similarities between this new species and both Lecanora rubina (now Rhizoplaca chrysoleuca) and the Lecanora fruticulosa complex (now in Aspicilia). Later (Tuckerman, 1882) he discussed the analogous variation in growth form in these last two species (from effuse and stipitate-squamulose, to peltate). The significance of such variation is still uncertain for these taxa (and in fact these inland species have sometimes been misidentified as one of his coastal taxa!).

Tuckerman (1872) characterized L. thamnitis as effuse and L. bolanderi as peltate, but stated: "There is yet no doubt, from specimens received since the publication of L. Bolanderi, that its fronds are developed from scattered, papillaeform granules." In 1882, he stated: "L. Bolanderi offers effuse conditions; as L. thamnitis, first observed only in such a state, passes finally into peltate ones, like the other." (emphasis added). Although Tuckerman (1882) claimed: "the two lichens, in large sets of specimens, are, so far distinguishable," he considered all three new taxa (L. bolanderi, L. thamnitis and L. phryganitis) as closely related to each other, and "...probably only forms of one species", with apothecia similar to those of L. pinguis.

Herre (1942), in discussing L. thamnitis under his description of L. bolanderi, stated: "An examination of specimens at the type locality revealed that a single colony showed every gradation from extreme bolanderi to extreme thamnitis." He went on to say: "Had Tuckerman, an able field worker, ever seen the plants growing, he would never have created L. thamnitis." This "type locality" (not specified), probably refers to San Bruno Mountain, where Herre had collected material somewhat transitional between the two forms (Herre 834, FH and US). Another Herre specimen from an unknown locality (UC 1208852) clearly demonstrates an almost complete range of morphotypes in a single patch.

My own observations of highly variable morphology of such material in both the field and the herbarium indicate that L. thamnitis is probably at most only a form or variety of L. bolanderi (as lectotypified above). The "L. thamnitis" morphotype is presently known mainly from the Oakland Hills, where it was apparently abundant and fairly uniform. It would be useful to have further knowledge of both morphotypes in localities where both occur together, to better document the intergradations.

Table 2. Comparison of Tuckerman's coastal fruticose Lecanora species. Items in **bold**, followed by asterisk (*) = from the protologues; those in parentheses ( ) followed by T72, T82 = from Tuckerman (1872, 1882); those in brackets [ ] = from the author's own observations, where they supplement statements of Tuckerman; numbers after colors refer to Kelly (1965). Underlined characters are considered in this study to be the most consistent and potentially useful for distinguishing L. phryganitis from both L. bolanderi and L. thamnitis, and for distinguishing L. thamnitis from L. bolanderi.

	Lecanora phryganitis	L. bolanderi	L. thamnitis
THALLUS	**fruticulose***; **caespitose-stipitate***; **forming rounded patches*** [usually with ± definite margin]; (dense, crowded --T82) [to loose]; [peltate or compacted into crust]; [patches ± uneven].	**fruticulose***; **caespitose***; **forming rounded patches*** [usually with ± definite margin]; (rather loose --T82); (peltate, but effuse at first -- T82); [patches uneven].	**fruticulose***; **caespitose-stipitate***; **forming verrucose crust without definite margin***; [very dense and crowded]; (can also be peltate --T82); [patches even].
Branches	**terete*** [at least below]; **erect, decumbent at margin** [irregularly branched]; **to 1 inch tall*** [to 5-10 mm in center, to 25 mm at margin]; (tips obtuse --T82) [not papilliform; to 1-3 mm wide, to 25-50 per cm^2].	**terete*** [compressed at margin]; **erect***, [decumbent at margin]; **dichotomously branched*** [±]; [to 5-10(-15) mm in center, not much longer at margin]; **tips papilliform, obtuse*** [0.5-1 mm wide, to 25-50 per cm^2].	**terete***, [also at margin]; **erect*** [also at margin]; [± dichotomously branched]; **somewhat over 1/4 inch tall*** [± uniformly 5 mm]; [tips papilliform], [mostly < 0.5 mm wide, to 100-200 per cm^2].
Color	**ochre-white*** [mostly pale yellow-green (121) to greenish yellow (104), turning pale yellow (89) in herb.]; [not distinctly pale spotted];	**greenish straw color*** [mostly grayish olive (109-111), turning yellowish brown (74-75) in herb.; distinctly pale spotted].	**greenish straw color*** [mostly grayish olive (109-111), turning yellowish brown (74-75) in herb.; distinctly pale spotted].
Surface	**rimulose-rugulose***; [often strongly verrucose to granular near tips].	[mostly continuous and even], [not strongly verrucose, not granular].	[mostly continuous and even], [not strongly verrucose, not granular].
Consistency	[rather soft, crumbling].	**cartilaginous***.	[cartilaginous].
APOTHECIA	**lateral***; **sessile*** (subsessile --T82); **large*** (to medium --T82) [to 2-4 mm diam.].	**terminal*** (subterminal --T82); **sessile*** (to subpedicellate --T82); **medium*** (to large [to 2-4 mm diam.].	**terminal*** (subterminal --T82); **subpedicillate*** [to sessile]; **large*** (medium --T82) [to 2-4 mm diam.].
Discs	**pruinose at first***; **yellowish flesh color*** (pale brick colored --T82) [mostly orange (53-54) to yellowish brown (75-77)].	**naked*** [mostly pruinose!]; **yellowish flesh color*** (passing into tawny --T82) [mostly yellow (86-87) to yellowish brown (75-77)].	[mostly pruinose]; **pale yellowish*** (passing into tawny red --T82) [mostly yellow (86-87) to yellowish brown (75-77)].
Margin	**scarcely prominent***; **subentire*** (flexuously lobed -- T82); [≤ ca. 0.2 mm wide].	[somewhat prominent]; **entire*** [to crenate or lobed]; **tumid*** [about 0.2-0.5 mm wide].	[somewhat prominent]; **becoming crenate*** [to lobed]; [about 0.2-0.5 mm wide].
ANATOMY	[loose medulla]; [algae mostly in definite layer].	**dense medulla***; [algal clumps scattered through thallus].	[dense medulla]; [algal clumps scattered through thallus].
Spores	**L:W = 3-4:1***, **oblong*** (to oblong-ellipsoid --T82); (12-16 x 5-7 µm --T82) [mostly 4-5 um wide].	**L:W = 1.5-2.5:1***, **ovoid-**ellipsoid [to ellipsoid]; 10-14 x 6-8 µm --T82) [mostly 5-6 um wide].	**L:W = 2-2.5:1***, **ovoid-ellipsoid*** [to ellipsoid]; 10-14 x 5-7 µm --T82) [mostly 5-6 um wide].
Asci	[axial mass narrow].	[axial mass broadened above].	[axial mass broadened above].
Spermatia	[(10-)12-15(-17) µm long].	[(12-)15-25 µm long].	[(12-)15-25 µm long].
CHEMISTRY	[xanthones, zeorin and unknown LPN-1; usnic acid].	[no xanthones or zeorin; with unknown CBL-1; usnic acid or isousnic acid].	[no xanthones or zeorin; with unknown CBL-1; usnic acid].

Considerations in Typification of Tuckerman's Taxa

Tuckerman did not designate type specimens or even mention specific localities in many of his descriptions, nor date any of his annotations, resulting in much confusion. The following information regarding the Tuckerman herbarium was kindly supplied by Mr. Gennaro J. Cacavio, current curatorial assistant at Farlow Herbarium (pers. comm., 1988). Between 1937 and 1939, curators at FH (Dr. David H. Linder and others) reorganized and indexed the Tuckerman collection and affixed red printed "type" labels to many of the specimens. Although they did not explain their choices, Dr. Linder wrote: "All the type specimens were marked by the additional time-consuming labor of search through the literature to determine accurately the types." One of these curators, Mrs. L. W. Riddle, also prepared the "Reliquiae Tuckermanianae" exsiccati (issued in 1942) from extra material which Tuckerman had set aside to distribute. In both cases the material was probably prepared without critical examination of specimens and distributed based on the data and determination provided by Tuckerman.

According to Dr. Donald Pfister, current curator at FH (pers. comm., 1988), it is unlikely that these early curators found any additional information regarding these taxa in Tuckerman's notes or correspondence. Because these "type" labels give no dates, names, or other information (other than citing the publication in some cases), this labelling by the early curators does not constitute valid lectotypification and without documentation does not offer proof of Tuckerman's intentions.

There is no reason to conclude that all of the original material of any of Tuckerman's taxa is missing (necessitating selection of a neotype). Without proof that any of the known collections were "definitely studied by the author up to the time the name of the taxon was published", lectotypes must be chosen from among collections that at least were "clearly designated by the original author", giving preference to "any indication of intent by the author...unless contrary to the protologue." (Voss, et al., 1983, Appendix T.4). Except where noted otherwise, the annotations mentioned below are undated, and in several cases it is difficult to be sure who authored them, but in any case this is not essential, since none of the specimens were clearly indicated as types by Tuckerman himself. Specimens that appear to be part of the same collection as the lectotype but do not have identical label data cannot be designated as isolectotypes.

Typification of L. phryganitis

Tuckerman (1866) cited the original material of L. phryganitis only as: "On sandstone rocks, coast; Mr. Bolander". The only locality mentioned by Tuckerman (1882) for this species was Mission Dolores (downtown San Francisco), which Herre (1910) referred to as the "type locality", stating that "material such as Bolander collected can no longer be obtained." (no material from San Francisco collected by anyone other than Bolander has been seen in this study).

Lectotype: Bolander 63 (FH) (Figs. 3-4).

The only collection labelled by the curators at FH as a "type" of L. phryganitis is Bolander 63, which contains four specimens (all similar to each other in anatomy and chemistry) on cards. One card has notes by Tuckerman comparing the species with L. thamnitis. The packet also has a note from Bolander, dated "1/12/64", saying: "No. 63. Quite abundant on metamorphic sandstone near the Mission Dolores and hence to the Ocean. Usually in depressions, forming there thick round patches. As much as possible I preserved that shape." (this note was cited by Tuckerman in 1882, but not in the protologue). This collection was chosen as lectotype because it fits within the protologue of L. phryganitis, was collected prior to the publication, and is clearly labelled (on all four cards) by Tuckerman, as: "No. 63. Bolander, California. L. phryganitis T."

Other Lecanora phryganitis specimens.

Other Bolander specimens of L. phryganitis seen in this study are quite similar to the ones in the Bolander 63 collection (FH), but do not have collecting numbers and are not annotated by Tuckerman. A specimen at US, Bolander, s.n., "1864-70, California" (labelled "authentic" by the curators at FH) is correctly identified (by Bolander?) as L. phryganitis. The locality, clearly in Bolander's handwriting, appears to be "Mission Hills" (possibly meaning Mission Dolores, in which case it could be part of the original material). However, "duplicates" of this specimen at FH and US are actually a Psora species!. At least one of several collections correctly labelled as L. phryganitis, from "San Francisco", Bolander, s.n., °/2 65 (sic; = unspecified date, February 1865) (FH) could have been seen by Tuckerman prior to publication.

Typification of L. bolanderi

The protologue of L. bolanderi cited only the following: "On rocks ('metamorphic sandstone') in Marin County, California, Mr. H. N. Bolander".

Lectotype: Bolander 29--thalli on the card (FH) (Fig. 5).

The lectotype of L. bolanderi consists of detached branches glued on a card, annotated by Tuckerman as "Lecanora (Cladodium) Bolanderi, Tuck., California, H. N. Bolander", and by Bolander as "No. 29. On metamorphic sandstone, Marin County". This specimen was chosen as lectotype of L. bolanderi for several reasons: 1) the thalli fit within the protologue, are from Marin County, and closely resemble other Bolander specimens labelled as L. bolanderi; 2) the card is clearly annotated by Tuckerman (although he referred to Cladodium instead of Squamaria as in the protologue); and 3) assuming the numbers are in chronological order, Bolander 29 could have been collected (and seen by Tuckerman) before Bolander's numbered collections of L. phryganitis (Bolander 63) and L. thamnitis (Bolander 125 and 155) and before publication of L. bolanderi. The material contains usnic acid and unknown CBl-1. Unfortunately, the Bolander 29 material is not of good quality: the thalli are moldy, do not show the growth form well, and bear only immature apothecia.

Other Lecanora bolanderi specimens.

Other Bolander collections of L. bolanderi from Marin Co. are similar to the lectotype in morphology and chemistry (usnic acid or isousnic acid; usually with unknown CBL-1) but are better specimens, and may be useful in understanding Tuckerman's concepts. Some of these specimens may well be parts of the same original collection, but with neither collecting numbers nor annotations cannot be called isolectotypes. These critical specimens include : Bolander, s.n., Marin Co., no other data (FH; UC 666809: both labelled as "type" by the curators at FH) and Bolander, s.n., no other data (FH: "ex Willey herb."). Another specimen, Bolander, s.n., Tomales Bay, near Olyma [sic]", undated (FH) (Fig. 6), is labelled "original specimens!", an expression that might have been used by H. Willey (at US) but not by Tuckerman (W. Culberson, pers. comm., 1988). This specimen, as is true for another one from this locality, Bolander, s.n., °/4 64 (sic; = unspecified date, March, 1864) (FH), may have been collected too late to have been used in the protologue.

Specimens excluded as types of L. bolanderi.

The packet labelled Bolander 29 at FH contains, in addition to the material chosen as the lectotype of L. bolanderi, an unannotated packet bearing thalli closely matching my lectotype of L. phryganitis. The presence of unlabelled packets such as this one can be explained by the following note by Tuckerman (dated 19 March 1876), from the archives at FH (Cacavio, pers. comm., 1988), which refers to his herbarium as a whole:

> "It does not follow, because specimens, evidently misdetermined, are placed in a certain wrapper, that I consider them to belong to the species for which that wrapper is designed, but only that a certain degree of resemblance leads me to place such specimens with such species till I examine it. It is just to me that this should be recognized; and throughout my collection."

This unlabelled packet associated with Bolander 29 may be the source of Mrs. Riddle's incorrect labelling of Reliq. Tuck. Exs. 108 (Bolander, s.n., undated, Marin Co.) as "authentic" material of L. bolanderi. All specimens of this exsiccat seen are L. phryganitis. The one at FH contains an undated note (by Bolander?) saying: "100, California, Bolander, Placodium novum" (the "100" may be Bolander's collection number; Tuckerman would not have referred to "*Placodium*", which he applied only to species now in *Caloplaca*).

Typification of *L. thamnitis*

The original collection of *L. thamnitis* was cited in the protologue as follows: "Sandstone rocks, with the last [*L. phryganitis*], Mr. Bolander." In the present study, no evidence was found that *L. thamnitis* and *L. phryganitis* were collected by Bolander from the same locality. Tuckerman (1882) mentioned two localities for *L. thamnitis*: 1) Oakland Hills (where apparently no specimens of fruticose Lecanoras have been collected since the time of Bolander, and suitable habitats may now be unavailable or inaccessible due to the build-up of the city), and 2) San Bruno Mountain (inferred by Herre [1945] to be the type locality; my search for *L. thamnitis* there turned up *L. phryganitis*!).

In the absence of other evidence, one of Bolander's Oakland Hills collections (discussed below) was chosen as the lectotype of *L. thamnitis* for the following reasons: 1) all of these collections are very similar to each other in morphology and chemistry (usnic acid and unknown CBL-1), are of good quality, and (except for for peltate thalli in some specimens) show the distinctive characteristics of the taxon as expressed in the protologue; 2) several are clearly annotated by Tuckerman as *L. thamnitis*; and 3) the locality was cited by Tuckerman (1882).

Lectotype: *Reliq. Tuck. Exs. 116* (FH) (Fig. 9).

Of the Oakland Hills collections, the *Reliq. Tuck. Exs. 116*, labelled by Mrs. Riddle as "determined by Tuckerman" and "type", was chosen as the lectotype of *L. thamnitis* for several reasons: 1) the specimen of this exsiccat at FH, labelled "isotype" by the curators, is annotated (by Tuckerman?): "*L. thamnitis*, Stock to publish, Bolander, California"; 2) although not showing the habit *in situ*, the thalli are of good quality and are only indistinctly peltate; and 3) choice of this specimen at FH as lectotype avoids further confusion, especially since *Reliq. Tuck. 116* (GZU) was the basis for the genus *Cladidium* Hafellner (see above).

Other critical *L. thamnitis* specimens.

One collection from Oakland Hills (*Bolander, s.n.*) shows especially well the effuse growth form of the attached thalli (Fig. 10).

Another Oakland Hills collection, *Bolander 125*, undated (FH) consists of three parts, all annotated by Tuckerman as *L. thamnitis*: 1) a card with effuse thalli attached to rocks, with Bolander's annotation: "125. This [is] the one I had in my former letters referred to. I send it now in all the various stages of growth."; 2) a similar set of effuse thalli, on a rock annotated by Tuckerman as: "*Lecanora thamnitis* T. in litt. ad Bolander" and by Bolander as: "This I found now quite plenty on rocks, Oakland Hills"; and 3) a group of clearly peltate clumps (Fig. 11) annotated by Bolander as: "On rocks (metamorphic sandstone), Oakland Hills. Is this *Lecanora B.?*". The annotations, and the peltate thalli (neither mentioned nor explicitly excluded in the protologue) are interesting in view of Tuckerman's changing concepts of the taxa (see above).

The only known Bolander collection of *L. thamnitis* from San Bruno Mountain, *Bolander 155* (FH--labelled as "co-type", i.e., syntype), is annotated by Tuckerman as: "California, Bolander 1865, *L. thamnitis* T." and by Bolander as: "155 *L. thamnitis* T. San Bruno Mts (sic). I send this also from this locality." These rather fragmentary thalli (Fig. 12), which were collected prior to publication of *L. thamnitis* (but apparently sent to Tuckerman at the same time as *Bolander 125*), are somewhat similar to the lectotype of *L. bolanderi*, and unlike the other material of *L. thamnitis*, they partly contain isousnic acid instead of usnic acid.

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Page 485	fig. 1	scale bar should read 1.5 mm, *not* 1.5 µm	
489	line 44	*for* (1986):	*read* (1987):
	46	*for* 23:501-507.	*read* 28:501-507.

ERRATA, VOLUME THIRTY-FOUR

Page 38	line 41	for *tesselata*	read *tessellata*
49	line 17	for *trachyosporum* var. *trachyosporum*	read *trachyospora* var. *trachyospora*
	27	for *trachyosporum* vars. *griseoviolaceum* and *purpureoviolaceum*	read *trachyospora* vars. *griseoviolacea* and *purpureoviolacea*
	lines 29,32,33,37,38	for *trachyosporum*	read *trachyospora*
	line 34	for *trachyosporum* var. *griseoviolaceum*	read *tracyospora* var. *griseoviolacea*
	36	for *trachyosporum* var. *purpureoviolaceum*	read *trachyospora* var. *purpureoviolacea*
	38	for *griseoviolaceum*	read *griseoviolacea*
50	line 1	for *trachyosporum* var. *purpureoviolaceum*	read *trachyospora* var. *purpureoviolacea*
165	line 7	for ligulus	read ligula
197	line 11	for dematum	read dematium
198	lines 18,21	for dematum	read dematium
200	line 3	for dematum	read dematium
201	line 20	for dematum	read dematium
202	lines 20, 22, 40	for dematum	read dematium
203	line 47	for dematum	read dematium
208	lines 8, 14	for dematum	read dematium
	line 28	for dematum	read dematia
213	lines 9, 12, 15	for dematum	read dematium
	line 37	for Arthroboytrum	read Arthrobotryum
214	lines 9, 10	for multiseptatum	read multiseptata
234	line 12	for saxicolum	read saxicola
	23	*for* Lecidella carpathica	*read* Lecidella carpathica
	37	for Aspicilictum	read Aspicilietum
235	line 12	for ochraea	read ochracea
	22	for spahaericum	read sphaericum
	lines 37, 39	for Aspicilictum	read Aspicilietum
236	lines 2, 3, 6, 12	for Aspicilictum	read Aspicilietum
	line 9	for carpatica	read carpathica
250	line 13	for togoense	read togoensis

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